

Aviation Week

and Space Technology

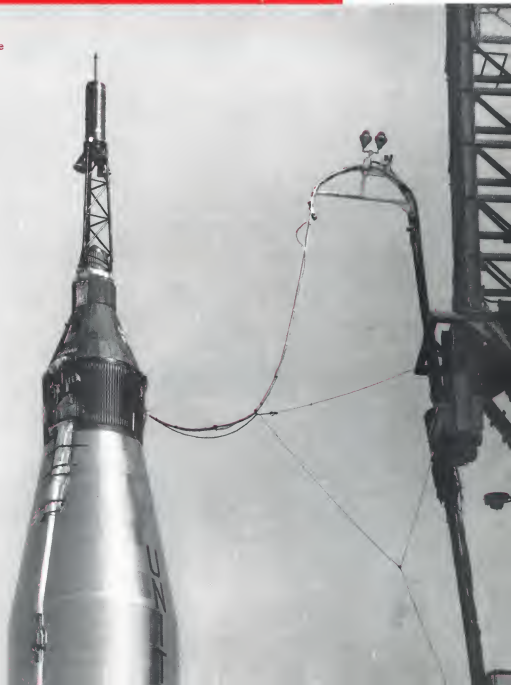
75 Cents

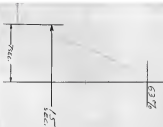
A McGraw-Hill Publication

February 5, 1962

**Hyper-velocity
Re-entry Test
Series Planned**

NASA MA-6 Capsule





The Visicorder Oscillograph records transducer response

A Type RM-100 "Silicon" temperature transducer, made by the R&F Corp., Hudson, N.H., is being tested here on a Visicorder Oscillograph.

The transducer is immersed in an ice bath and then is bathing water. If the tiny metal grid is not adequately bonded to its rubber carrier matrix, the temperature response to the cold/hot bath is seriously changed. The Visicorder Oscillograph record shows that the R&F transducer under test had a proper grid-connection bond because it met the specified time response to temperature change.

In countless applications, Visicorder Oscillographs can directly record up to 36 channels at frequencies from DC to 5000 cps.

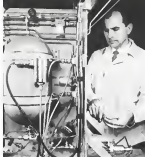
For details, write: Minneapolis-Honeywell, National Division, 4800 E. Dry Creek Road, P.O. Box 6770, Denver 19, Colorado. Use DDD phone number is 303-754-6211.



Honeywell

H First in Control

TYPE 3264
TEMP. 32° TO 212°
65% RESPONSE 7 SECS.
90% RESPONSE 15 SECS.
ORDER NO. 13050 for N.H.
DATE 6/24/61 TEST BY JHC



Special test facilities developed by Vickers Research and Development team are used to evaluate nozzle designs, fuels, controls, instrumentation, etc. This setup is used in hypergolic propellant studies.

CAPABILITY is spelled a-t-t-i-t-u-d-e c-o-n-t-r-o-l

Selection of the optimum attitude control system for a particular missile or space vehicle requires special technical skills, facilities for conducting the necessary test program, and knowledge solidly based on related experience. All these are available "in quantity" at Vickers.

Actual experience dates back to hot gas servo studies initiated in 1955 and now covers the additional areas of hydrogen peroxide-powered reaction control, hypergolic propellants and secondary reaction systems using either liquid (frozen), or hot gas bleed from engine combustion chambers.

The facilities and skills responsible for these developments in attitude controls are available to you as a vital aid in solving the problems of space-flight orientation. For more details, write for Bulletin A-5264, and/or call the Vickers' Application Engineer in your area. He is a thoroughly experienced professional in the "Programmed Power" field.



Nozzle designed for hypergolic propellant shown under test. Flame temperature 1460°F. Exhaust flame is characterized by well defined series of shock diamonds.

VICKERS INCORPORATED

DETROIT 30 MICHIGAN
TORRANCE, CALIFORNIA

division of
SPERRY RAND
CORPORATION

"PROGRAMED POWER IN:
POWER TRANSMISSION
ENERGY CONVERSION
FLUID TRANSFER



Space vehicle simulator used in development of attitude control system. In this 2 tone, psi can be set in motion with a finger touch. First tone and is supported on a 3-inch steel ball that floats on a hydrostatic bearing and is free to move in three planes: pitch, yaw and roll.



INPUT FROM OUT THERE

Man's comprehension of the cosmos grows with his ability to assess and control the space environment. This is the task of avionics—the discipline that integrates avionics, optics, mechanics, and the information sciences into united systems.

Avionics General's Avionics Division, manufacturer of the vibrant displays of the MDUS satellite, offers complete capability in research, development, and production of advanced avionics systems for—

- Guidance and Control
- Target Detection and Identification
- Searching and Tracking
- Electronic Support
- Information Sciences
- Radiometric and Spectral Analysis

**ASTRONICS
DIVISION**

**Aerjet-General
CORPORATION**
Azusa, California

MEMBER OF THE GENERAL TIRE AND RUBBER COMPANY



Engineers, scientists—investigate outstanding opportunities at Aerjet.

AEROSPACE CALENDAR

(Continued from page 5)

- Aerospace Products Show, Aerospace Society of Mechanical Engineers, Great Hall, Houston, Tex.**
May 13-14—*Symposium of the Aerospace Society: Population Meeting* (Invited) Cleveland, Ohio
- May 14**—*Electric Propulsion Conference, American Rocket Society Held* (Closed) Berkeley, Calif.
- May 16**—*Annual Robert H. Goddard Memorial Symposium: "Tropics and Artificial Satellites"*, American Astronautical Society, Washington
- May 26-27**—*Symposium of Deviers' Secret National Symposium on Hypersonic Technology*, Denver, Colo.
- May 26-29**—*International Conference in State of Radio Engineers, Galveston and Walden, Austin, New York*
- May 27-29**—*Third Symposium on Lightening Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y.* *Symposium American Institute of Electrical Engineers, Institute of the Auto Space Science, Institute of Radio Engineers, University of Rochester*
- May 29-30**—*Fourth Annual Electronic Beam Symposium*, Allied Electronics Corp., Cambridge, Mass.
- Apr. 14**—*Mid-Year Conference, Argon Operation Council, Sheraton Hotel, Washington D. C.*
- Apr. 15**—*Launch Vehicle, Rockets and Missiles Conference, American Rocket Society, Rensselaer Inst., Phoenix, Ariz.*
- Apr. 16**—*National Airman's Meeting* (including production Round) *Society of Automotive Engineers* (Held) *Congress*, New York, N. Y.
- Apr. 19-21**—*Second Symposium in the Plasma State—In Effect Open Space Communication and Detection*, New England Medical School, Boston. *Sponsor: U. Cambridge, Research Laboratories*
- Apr. 21**—*Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.*
- Apr. 22-23**—*Annual Technical Meeting and Symposium* *Explosion Institute of the International Research* *Scientific Group* (Held) *Chicago, Ill.*
- Apr. 24-25**—*Second Conference on Kinetics, Equilibria, and Performance of High Temperature Systems* *University of California, Los Angeles, Calif.* *Sponsor: Westinghouse Electric Company, Los Angeles*
- Apr. 26-28**—*Annual Symposium, College of Aeronautics, Cranfield, England*
- Apr. 26-28**—*Acoustics Institute, Acoustics Symposium, Institute of the Acoustics Society, Salt Lake City, Utah*
- Apr. 28-29**—*High Pressure Institute of Breakdown Symposium on the Mechanism of Thrombosis, United Engineering Center, New York, N. Y.*
- Apr. 29-30**—*Mid-Year Space Age Institute and Engineering Exposition*, Con. Plaza, New Orleans, La.
- Apr. 30**—*May 2*—*Meeting on Material Science, Flight, Institute of the American Society, Hotel Chateau, St. Louis, Mo.*
- May 2-3**—*Spring Joint Computer Conference, Flamingo Hotel, San Francisco* (Continued on page 6)

Involvement: LIFE



PRESERVATION...

Since time began, man's concern has been preservation—in peace, in war, in the exploration of new horizons. With each breakthrough in the dynamic world of science, there must always remain the basic rule: Take all possible precaution against the loss of human life.

This is the creed of Stanley Aviation, leader in the design and development of aircraft escape and survival systems.

The growth of this young and vigorous firm has created a need for additional specialists who possess a desire to cross into unknown frontiers. But these must be individuals who match the company's primary interest in and dedication to man's protection—and preservation—under all conditions.

If Stanley's Involvement: LIFE interests you and if your professional specialty encompasses magnetohydrodynamics, design engineering, aerodynamics, computer engineering, or similar disciplines, you're invited to direct your confidential reply to Mr. E. Franklin, Personnel Manager.

Stanley
AVIATION CORP.
2801 SULLY STREET
DENVER 8, COLORADO
An equal opportunity employer



WHAT IS NEW IN HYDRAULIC MOTORS?

Answer: The *synchro-drive* model **Rein® HYDRAULIC MOTOR** is a positive displacement vane motor of a periphery design capable of providing continuous, intermittent, rapid reversing, or stalled service. Pressure balance relief also support by a hydrodynamic bearing results of low friction operation over the entire motor speed range. The motor is suitable for servo or non servo operation. For servo motor operation the servo valve is mounted directly to the motor. The

**IT IS
NOW
A
HYDRAULIC
MATTER?**

Design engineers need more
adaptors and thereby reducing
the manifold fluid volume
results in a high hydraulic
efficiency and excellent noise
response. Data from 07 to 9000
rpm in revolution. Quickly to 3500
RPM. Bendix design experience
includes advanced hydraulic sys-
tems for various aircraft
engine, and turbine use. Let Bendix
help you with your systems requirements.

Write: Manager, Fluid Power Equipment Sales,
Bendix Products Marketing Division, 5000



Bendix Products Aerospace Division



AEROSPACE CALENDAR

(Continued from page 7)

- Mar 24-25th Annual National Forum
American Hydrographic Society, Shattuck
Park Hotel, Washington, D. C.
- Mar 26-27th Annual Meeting of the
Geological and Space Research and
Technology Exhibition, American English
Society, United States Information Service
- Mar 3-4-6th and International Congress on
Space, American English Society, United
States Information Service, Lakeview Hotel,
Long Beach, Calif.
- Mar 7-9-Materials & Processing for Space
Experiments, American English Society,
Aerospace Material and Process Exhi-
bition, Hotel Statler, St. Louis, Mo.
- Mar 7-11-Annual Astronautics Society at
Phoenix, American English Society, United
States Information Service, Phoenix Hotel,
Phoenix, Ariz.
- Mar 7-11-Annual Astronautics Society at
San Francisco, American English Society,
United States Information Service, San Fran-
cisco Hilton, San Francisco, Calif.
- Mar 11-12th Annual Electronic Design Con-
ference, American Electronic Design Con-
ference, Inc., Dayton, Ohio
- Mar 14-15-16th Annual Astronautics Society
Meeting at Dallas Symposium on Space
Technology, American English Society, Uni-
versity of Colorado, Colorado Springs, Colo.
- Mar 14-15-16th Annual National Cancer
ociety of America, American English So-
ciety, United States Information Service,
Phoenix Hotel, Phoenix, Ariz.
- Mar 28-29-Annual Conference, American
Association of Airport Executives, Ambassador
Hotel, New York, N. Y.
- May 27-28-1968th Aerospace Instruments
for Space and National Technology
Conference, Statler Park Hotel, Wash-
ington, D. C.
- May 27-28-Conference on Self-Organizing
Systems, Michigan of Science and Indus-
try, Chicago, Ill. Sponsored Office of
National Research, American Research Foun-
dation
- May 28-29-Annual Microelectronic Theory &
Technology Symposium, Institute of Mi-
croelectronics, Santa Monica, Calif.
- May 29-Bioscience Region Conference on
Space Communications, Institute of Tele-
communications, Seattle, Wash.
- June 1-2-3-4th Annual Conference for the
United Nations World Conference, National
Ordnance Laboratory, Silver Spring, Md.
Sponsored U. S. Navy, American Society
for Space Research
- June 8-9-10th National Microelectronics
and Quantum Theory, Reading, American
Physical Society
- June 10-11th Annual Meeting, Ohio Teacher
and High Mathematics Institute, University
of Washington, Seattle, Wash.
- June 11-12th Annual Space Symposium, Santa
Monica, California, American Society for
Astronautics, Santa Monica Hotel, Santa
Monica, Calif.
- June 25-26-27th National Conference on
Military Electronics Institute, of Radio
Engineering, Santa Monica, Calif.
- June 29-30th Symposium on Electromagnetic
Theory & Antennas, Copeland, David
Spencer, Technical University of
Denmark, International Scientific Radio



Space age potter's wheel

blasting center in built on the advanced spin forge is only one of the many out-of-the-ordinary manufacturing operations carried on by The Marquardt Corporation. The completely integrated production facilities were built, staffed, and equipped specifically to serve the aerospace industry. A half a million square feet house one of the most extensive subcontracting facilities in the West, spin forging, high-energy forming, heat treating, metal processing, advanced machine shops—all are manned by an experienced work force with a demonstrated capability in methods engineering, metal forming, and fabrication. For further specific information on how Marquardt Manufacturing can help solve your mass production problems, economically, and on time, write or call H. C. Petta, Department A, Manufacturing Services.

THE *Marquardt* CORPORATION

1000 WEST 3RD STREET, OGDEN, UTAH

LET WESTERN GEAR GIVE YOUR VTOL PLANS A LIFT

It takes power to take off and land a plane like this in the length of its shadow. Controlled power. Precision power. Engineers at Western Gear's Precision Products Division are thoroughly qualified to solve power transmission problems like this.

The state of the art of weight to horsepower in gas turbine power plants is dictating similar advancements in the power transmission drive systems for VTOL type of aircraft.

This skill and capability is a resource you should tap. Whether your VTOL interests are in turboprop or ducted fan configuration, the

heart of the system is high speed gearing and shafting. Western Gear is already working with advanced concepts in these fields. Let us show you how this can be of vital importance to your VTOL plans.

Address: Precision Products Div., Western Gear Corporation, Box 192, Lynwood, Calif. Cable address: WESTGEAR, Lynwood, California.



Remote high-pressure coupling

between lines carrying
10,000 psi

is now possible with the new Deutsch quick disconnect fluid and gas coupling. Remote connection can be made with any available "push." Absolutely no twisting or tricky lock movements are necessary for complete coupling and seal.

To assure safety at high operating pressures a color ring provides visual inspection for positive lock, and quick-disconnect can be accomplished only by applying pressure directly to the coupling ring. Both halves of the true quick-disconnect exceed all requirements of MIL-C-26427 for fluid loss, air exclusion, pressure loss and physical shock. And it will operate properly over a temperature range of -200°F to +450°F.

So if you have a remote, umbilical or rack-and-passer coupling application write today.

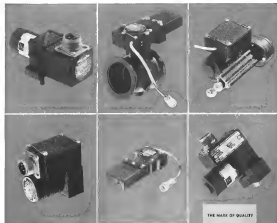
Ask for Data File A-1

DEUTSCH

HYDRAULIC COMPONENTS DIVISION P.O. Box 73205 • 75002 Dallas, Texas • Los Angeles 9, Calif.

new family of electromechanical actuators by Barber-Colman brings important space and weight savings to aircraft and missiles

The new NYLC series of compact Barber-Colman actuators offers you a wide selection of travel and load limit types to help solve critical space and weight problems. The various actuators shown below are individually designed for applications from 25 lb-in. up to 300 lb-in. torque (linear actuators up to 300 lb.). The first in this new actuator series, developed for a valve application, resulted in 56% volume and 55% weight reduction over previous types. From its basic design the others were developed to give you a broad choice of configurations, load, speed, and travel characteristics. Other features include externally adjustable adjuster stops, externally adjustable limit switches, and compact radio noise shielding. For complete details write for literature or consult the Barber-Colman engineering sales office nearest you: Baltimore, Boston, Dayton, Fort Worth, Los Angeles, Montreal, New York, Rockford, San Diego, Seattle, Winter Park, Florida.



BARBER-COLMAN COMPANY
 DEPT. 8, 5423 ROCK STREET, ROCKFORD, ILLINOIS

AIRCRAFT AND MISSILE PRODUCTS: AIR VALVES, ELECTROMECHANICAL ACTUATORS,
 TEMPERATURE CONTROL SYSTEMS, POSITIONING SYSTEMS, SOLENOIDS, TRANSDUCERS
 AND THERMOSTATS. SPECIAL DRIVING TEST EQUIPMENT, POLYUHM ENCLOSURES

TYPICAL CHARACTERISTICS

Rotary Type

Rated load up to 300 lb-in.

Temp. range -60° to 250° F

Typical weight 0.75 lb.

Linear Type

Rated load up to 300 lb.

Temp. range -60° F to 200° F

Typical weight 1.25 lb.



FAR OUT

One of the most advanced nuclear projects of our time is the development of SNAP compact reactors for space. Atomic International is deeply involved in this "far out" work. AI is developing a series of compact reactor systems that will be in use for communications and will also have world-wide TV applications as well as stationary and mobile terrestrial uses. Our development is a challenge worthy of the most dedicated engineers and scientists.

Immediate opportunities are available in:

Core Analysis—Core analysis of compact reactors including both core stability, reactivity coefficients, control systems and stability analysis (core transients, amplitude response, interpretation of oscillator and noise measurements).

Heat Transfer—Senior Engineers to be responsible for system engineering studies on the thermal, hydraulic and thermodynamic performance of compact power reactor systems.

System Analysis—Analysis and simulation of complete nuclear power plants to develop reliable unfueled, completely automatic control and instrumentation systems, including reactor kinetics, dynamics, hazards and reliability analysis.

Hazards Analysis—System safety and hazards studies on

compact nuclear power systems for space applications. Background in radiation shielding and radiological hazards evaluation desired.

Control Analysis—Dynamic control and simulation studies to establish stability and control specifications for compact nuclear power plants being developed for space applications. Familiarity with latest analog and digital techniques required.

Space Environmental Testing—Component development and space environmental testing of nuclear power plant components including high vacuum, vibration, shock, thermal and mechanical testing.

Please contact Mr. J.D. Newlen, Personnel Office, Atomic International, 899 DeSoto Avenue, Canoga Park, Calif.

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

ATOMIC INTERNATIONAL

Division of North American Avco



ADVANCED AIR DEFENSE SYSTEMS WITH FIRST-DAY CAPABILITY

The needs of today's air defense systems pose a problem that would have seemed insurmountable ten short years ago. The problem of furnishing aimed-weapons command and control, with first-day capability, is a system that is portable to any place in the world.

Here is how that problem has been solved through creative engineering utilizing a decade of industry progress in tactical data systems:

Systems already delivered by Littton to the military, or in the advanced state of development and production, include: Airborne Tactical Data System (AN/ASQ-54, AN/ASA-27) for the U.S. Navy, the Marine Corps Tactical Data System (AN/TQ-1, AN/TYQ-2) for the U.S. Marine Corps, and the AN/FSG-1 Retrofit Improvement System (QA-308, FSG-1 (V)) for the U.S. Army.



The second of these systems, the Marine Corps Tactical Data System (MTDS), features capabilities for continuous and effective control of Combat Air Operations during an amphibious assault. Facilities are available for control of aircraft on missions such as close air support, reconnaissance, and interdiction and for air defense with mixed weapons, both ship-based and shore-based surface-to-air missiles and interceptors. An integrated air traffic control system assists in initial and continuous identification of friendly aircraft.

The third, the AN/FSC-1 Retrofit Improvement System, significantly increases the counter-countermeasures capability of the AN/FSC-1

Missile Master System deployed within the Continental United States



States to furnish surface-to-air missile battery coordination in the defense of large cities and industrial areas.

Through the successful design, development and manufacture of systems for air defence missions, Lottus has demonstrated its capability to proceed with even further advanced data systems. Such systems are now under conception and development at Lottus.

air defense systems that not only fulfill today's defense requirements but also defy obsolescence for years to come require engineering that is versatile, innovative, aggressive, and adaptable. This is the kind of engineering Littern expects from its people. If you are qualified to perform engineering at this level, you are invited to write to R. Law, Littern Systems, Inc., Data Systems Division, 6700 Ross Avenue, Canyon Park, California, or telephone (916) 64-4080.

By David Christopher Johnson



The first of these, the Airborne Tactical Data System, provides a capability for the mission of Airborne Early Warning and Control (AEW & C) in defense of large land masses, attack carrier task groups and other naval units. Both the AN-



DATA SYSTEMS DIVISION
LITTON SYSTEMS, INC.

A DIVISION OF LITTON INDUSTRIES

DATA HANDLING & DISPLAY SYSTEMS • COMPUTER SYSTEMS • MODULAR DISPERSED CONTROL SYSTEMS



MIRACLE OF MOBILITY TAKING SHAPE

The above photo is tangible evidence of a constant assault on transportation in the mining. This is a pressurized cabin section of the Jet Comander, a new 500 cph, 6- to 8-place executive aircraft which combines jet speed with exceptional short field capability. Regardless of the transportation equipment you now employ, the Jet Comander will double—perhaps triple—the mobility and the productivity of your men on the move.

The Jet Commander is for sale now under a purchase agreement which guarantees the delivery date and

the price. Production is progressing on schedule and deliveries will begin in late 1963 to those district school management teams who have already placed orders.

SEE THE ADVANTAGES FOR YOURSELF

See a 15 minute film—a your own affair, at no obligation—which fully illustrates the benefits and capabilities of the new Jet Commander. Just mail for coupon for a show-up at your nearest Jet.

Mr. R. B. Charles, Vice President Sales
Auntie Corporation, Inc.
Berkeley, California
Dear Mr. Charles:
Please arrange for us to see your new film, the **ST COMMANDER**
☐ Please call at this office on (date) _____
☐ Please place it (in the) _____ for an appointment
NAME _____ TEL. _____
CO. NAME _____
ADDRESS _____
CITY, STATE _____

© 2000 CHRYSLER, INC. ALL RIGHTS RESERVED. CHRYSLER, CHRYSLER CREDIT CORPORATION AND CHRYSLER FINANCIAL GROUP ARE REGISTERED TRADEMARKS OF CHRYSLER CREDIT CORPORATION. CHRYSLER FINANCIAL GROUP IS A SERVICE MARK OF CHRYSLER CREDIT CORPORATION.



DETERMINE
 ΔT TO
0.000001° C!

Essential Histoneoctylamine Tumor

EP0005—A, heat-on, metal-oxide type photoresist. The resist is a type photoresist polymerized silicon alloy. Spectral response 2 to 14 microns. Good emulsion property. Coating: sputter layer or stripes (for detector component at 20%) or liquid mass (for detector component at 21% K).

[illegible][illegible][illegible] The Most Trusted Name in Electronics

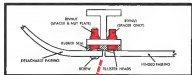
documented disease signatures of Fuchs' disease, from the cornea, and those

RIVNUTS® PROVIDE

HIGH-STRENGTH NUTPLATES FOR DETACHABLE FAIRING

Designers of the Boeing Vertol 107 helicopter required a simple but sure method of fastening the detachable aluminum fairing around the forward pylons. BFG Rivnuts met every requirement—light weight, high-strength threads, easy installation. A total of 30 Rivnuts are installed in structural members to permit screw fastening of the fairing, in addition six Rivnuts

serve as gasket spacers. Installation is simple—with a heading tool one must install the Rivnuts blind (from the exterior of the work) in a few seconds. Rivnuts are the original blind rivets with internal threads. They provide superior fastening and reduce assembly costs in many applications. See how if they can help on your fastening problem.



WRITE FOR DATA BROCHURE
Informational brochure describes principle of Rivnuts, shows typical applications, lists size and cost data. See brochure in Research Position Design File or write Development & R&D, BFG Goodrich Aerospace and Defense Products, a division of The BFG Goodrich Company, Akron, Ohio 44316. Enclosure, please.



BFGoodrich Rivnuts



EDITORIAL

Airline Sales Problems

Some fundamental changes in the attitudes of airline management toward their customers, both current and potential, must begin to enter the air transport picture in 1962 if this industry is ever going to match its own capacity with a new market and get back on a comfortable profit curve.

The technical aspects of the jet age are now pretty well in hand. The operational personnel at the airports and manufacturers have done a magnificent job in reaching that state so soon in the history of this revolutionary form of air transport. Traffic control is of course still a major bottleneck, but this is a problem that awaits the jet transport. Perhaps the major operational problem still confronting jet operations is the drive toward the ultimate goal of all-weather operations and 100% schedule reliability. Again both manufacturers and airline personnel are tackling this problem with vigor and ingenuity.

However, we suspect that the full implications of the jet age have not yet been fully assimilated by airline sales organizations, although they are certainly able to see the empty seats gaping dumb in the long fuselages of their new equipment. Airline seats are a highly perishable commodity with the seat not sold today gone forever. As long as the basic factors of population expansion and business activity were rising at a comfortable rate during the post war decades and airlines were offering the potent opponent seat capacity, their sales departments had no acute problems. As AIRWAYS WEEK, Transport Editor L. L. Dohi emphasized recently (AW Dec. 25, 1961, p. 24), this flying along on a rising economy carried most airline sales organizations a reputation for either inactivity that was now turned out to have been ill-desired.

Twin Sales Spurs

Except for relatively minor fluctuations, these twin spurs of expanding population and growing business activity should continue to give the airlines an economic stimulus over the next decade. But this alone will not be sufficient to meet the almost insatiable seat capacity of the high velocity jet transport. And herein lies the new and critical challenge to airline sales organizations. In dread of flooding coast-to-coast along on a rising economic tide, they are going to have to get out and scratch and hustle with an energy and ingenuity not yet apparent in their post war activities.

We also suspect they are going to have to sell their airlines' services in a somewhat different manner than their traditional dictates. To put it bluntly, today's airline passenger wants service, not cheapness. In the past

powered on, flights were relatively long and something was needed for the passengers to distract them from the noise and vibration and all these otherwise empty leers. Flabiate food and beverage service filled the gap nicely and the quality of an airline's cuisine was an important sales point.

Now, however, the relatively short flight times of jet service coupled with generally deteriorating quality of cabin service (insufficient and poorly trained "stewards") has reduced the sales value of this trained "steward." Where the passenger really needs and wants service is on the ground. And here he finds his flight generally none in the jet age than before. Lines at ticket counters are longer, check-in processes so simpler, walking distances from counter to boarding areas get longer in each new modern terminal and ground transportation is taking a larger portion of his total travel time—in many cases as much as half of his total time.

Selling Safety

Airlines instinctively shun away from safety as a sales problem. But there is no doubt that fear of flying is a potent factor in limiting the expansion potential of the flying public. This is a obvious problem but the do has passed when airlines can sweep this area under the rug and pretend it doesn't exist. They are going to have to do something about it if they really want to expand their market.

There has been very little market research worth of the nature in the air transport business. We doubt very much whether any such market research conducted by the Civil Aeronautics Board or any other government agency would really do the airlines much good. But they are going to have to develop this field as an effective sales tool if they expect to make any real penetration into other competitive forms of transportation. Here again, we suspect what will have more people aboard the airlines is increased service and utility and not free champagne.

What is really needed is an new and effective air line sales technique in the face realization that the air transport industry made a fundamental change in its nature when it entered the jet age. In old appeals have faded like last year's truck trailers. In their place the air transport industry has acquired new and, we think, vastly more appealing features. It is up to the airline sales organizations to find out what the traveling public really wants and then give it to them instead of continuing to force unneeded methods down their throats like flat champagne.

—Robert Hote

Available in flush and hex heads

With a density of only 0.65 lb. per cubic inch—less than one-fourth that of steel—barylene can account for truly extraordinary efficiency in space programs. The extreme cost of *arbiting* a pound of satellite is reckoned at about \$15,000. This would be the cost, then, for a pound of steel fastener with holding power of, say, 85,000 lbs. in shear. But the same quantity of barylene fasteners of equal strength would weigh less than 14 lb. So they would cost only about \$3,350 to install.

Further proof of Ingersoll's superiority is the fact that today's fasteners of this material have a shear strength of 50,000 psi (pounds per square inch). To achieve an equal shear strength-to-weight ratio, it would be necessary to use a heat-treated steel flange having a tensile strength of 50,000 psi. Yet the strongest steel bolt in production—another metric SPS development—is rated at 300,000 psi. Yet to produce a product that weighs as much as a nut of this material, it would be necessary to use a steel flange with a tensile strength of 300,000 psi. The use of the SPS material provides a fastener with a strength-to-weight ratio that is 10 times greater than that of titanium, 100 times that of aluminum and much stronger, for instance, than SPS with fabrication techniques considered in the fastener industry, was able to overcome them. It was discovered that threads, contributing by far the most critical area, had to be added with a large smooth finish. The ideal condition was found to be a further deceleration of the thread to a 100% finish. The threads were then finished to a depth of 33%. The result? Fatigue life was increased a millionfold.

In new designs where weight reduction is of critical importance, consider leverjoints both — now being produced in quantity in three heat-treated configurations — "Hi-Torque" finish head, "Torque" finish head and base — for use in a wide variety of aircraft, missile and rocket applications. For further information, write STANDARD FERRITE STEEL CO. — manufacturer of precision hardened leverjoints and allied products in many metals. AIRCRAFT/MISSILE DIVISION, SPS, JENKINTOWN 3, PENNSYLVANIA • RANFA AKA, CALIFORNIA

Comparison of mechanical properties by strength-to-weight ratio—of kevlar® bolts with steel and aluminum bolts of A193-B8L configuration (values are given in stress, density ratio—pdlb/in. cu.)			
Density of kevlar® bolts	1.38	Q840	By New 41
Density of aluminum bolts	2.80	By New 41	41
Density of steel bolts	7.80	By New 41	41

Category	Item	Value
Furniture	Chair	100,000
	Table	100,000
	Bedroom	100,000
Sofa	Chair	40,000
	Table	80,000
	Bedroom	80,000
Furniture	Chair	10,000
	Table	20,000
	Bedroom	40,000

SPS

where ρ is the probability

In the Front Office

Fred T. Soren, president and chief executive officer of Chicago Aerial Industries, Inc., has been elected to succeed Marvin B. Rafkin, resigned. Soren continues as vice chairman of the board.

William F. Fox, president, chief executive officer and a director of Voltec Industries, Inc. (formerly the Minneapolis-Voltec Co.) St. Paul, Minn., according to Edward F. Byrne, counsel.

Frank W. Lench was president and manager Sales Support Department, Northwestern Division of Northrup Corp., Van Nuys, Calif. according to J J West, a signed Ray F. Miller memo. Lench was vice president and manager Electronic Systems and Equipment Department of Northrup Aerospace, Calif.

David S. McNally, 100 percent Applied Connector Division Applied Tool Electronics Corp. and general manager of the Applied Western Division Chatsworth, Calif. according to James H. Schaefer, agent.

Daniel E. Willett, executive vice president, Medford Race Corp., Cheshire, Conn.; Robin A. Bell, general manager of the Jantrol Heating and Air Conditioning Division, elected a group vice president; and James W. Ashby, general manager of the Jantrol Air Division, elected vice president of the company.

John R. Allen, corporate vice president, worked with Northing Corp., Beverly Hills, Calif.

Russell A. Kimes and **Stanley E. G. Hays** are 1992 presidents, American Machine & Foundry Co., New York. N. E. Kimes is also a past president and director of operations of AMF's Government Product Group. Hays heads AMF's newly created Planning and Performance Division.

Honors and Elections

Newman A. Linsmeier, director of Weather Service of the United States Weather Bureau, has received the Flight Safety Foundation's distinguished service Award of Merit presented on behalf of American West and Space Transportation for "many contributions to the improvement of aviation weather forecasts."

Josephine Goddard has been awarded the 1961 General Electric Trophy, which is presented annually for significant achievement in aviation, for setting eight new speed, distance and altitude records in the Northrop T-38 Talon supersonic trainer.

Continued on page 87

● Strong objections to Air Force's suspected study of a numeric, roving laser vehicle (AFW Dec 18, p. 56) have been cited by National Aeronautics and Space Administration. Circulation of a USAF war statement on the roving vehicle last year caught NASA's Jet Propulsion Laboratory, which has repeatedly delayed its Precursor moving vehicle program, completely unaware NASA claims the USAF study would duplicate much of the work to be done under the Precursor and Apollo manned spacecraft programs. USAF insists it has manpower to run the study, which could begin sometime next year, after confirmation that will be needed by Precursor.

► L350 Hammingbird, Lockheed's sequenced, deflected-thrust VTOL jetter (AW Dec. 14, p. 30), carries the Arm designation VZ-10. Its maximum speed is calculated as 720 mph, and its service ceiling of 40,000 ft is fixed by pressurization limits.

► Aztec's Fiscal 1993 budget request provides only about \$900,000 for the Field Aztec Electronic Missile Defense System (FEMADS), barely enough to begin development of the complex, system. Major contenders for the program are General Electric and Raytheon. GE had proposed a more sophisticated, more costly system. Aztec may use whatever Fiscal 1993 funds it can get for continued studies of the system.

► Apollo recovery system will consist of a three-parabolic chute, each one 50 ft. in diameter (AW Dec. 4, p. 21). Biggest problem involved is safe recovery of the three new chutes in shock atmosphere on landing.

► Present configuration of the Fokker F-27 prepared STOL, follow-on in the F-27 turbo-prop transport, is expected to use two Royal Canadian Air Force CF-119 turboprop aircraft, modified on prime beneath each wing, plus a series of the Rolls-Royce Spey, to convert horizontal thrust

► Jet Propulsion Laboratory has tabled its plans for study of a lightweight rocket system for returning lunar samples from Servicer self-landed stationary lunar periscope. Sample return was not one of Servicer's original missions but later was regarded as a feasible add-on requirement.

►Holliston, Northeast Division of the Seeger Corp., Anaheim, Calif., is developing a small telepresence system to be mounted on the lapel of a flight instructor of the General Dynamics Convair upper stage, for the first in-flight tests. The system will monitor behavior of the crewmember propellant during powered flight and some environment.

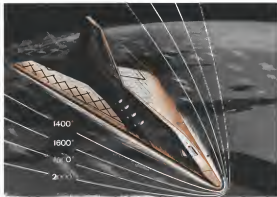
► Army is evaluating the Mark 2 STOL version of the de Havilland Carbon transport. Planned powerplants are two General Electric T64 turbo-prop engines. The Mark 2 version also is an entry in the current NATO competition for a medium-size STOL transport.

► New techniques for producing aluminum oxide, calcium fluoride and other crystalline and noncrystalline materials in a variety of configurations (films, in optical systems (lenses)) will be taught in a research program to be sponsored by the Army Signal Corps. Request for proposals were to be issued last month. Signal Corps also plans to sponsor research on thin film metal oxide semiconductors.

► Mercury tracking network will be modified extensively for use on Gemini, two-man capsule flights and later for the Apollo 4 three-man capsule. Five stations will be added; three on ships, one in Guam, one in Chile.

► USAF's Air Proving Ground Center at Eglin AFB, Fla., is seeking concepts for new types of air-to-ground weapons and techniques for dispensing those from current operational aircraft.

► **Missile Impact Locating System, (MILS)**, used to determine accuracy of ballistic missiles, will be employed in a backup system for locating the Mercury capsule in case it lands in the ocean outside of a designated impact area after a missed orbital flight.



Atmospheric Skin Diver... 1980 Style

Double-walled honeycomb panels of Haynes alloy No. 25 may form the "skin" of a rocket-propelled space glider, pending a major aircraft company. Already successfully tested, these panels are designed to withstand the corrosive temperatures generated as the glider dives back into the earth's atmosphere.

To safeguard the plane's 20 passengers and crew from the blazing re-entry heat, its whole skin, except for leading edges and tail surfaces, will be made of the Haynes alloy No. 25 panels. Beneath them, a layer of thermal insulation. And liquid circulating through inner walls and stiffeners will lose excess heat to water to be expended as steam. Research indicates that a "skin" of this basic type is highly practical. And it seems certain that many other tough, heat- and corrosion-resistant Haynes alloys—some already proved at 3,000 deg. F. and above—will also be aboard.

Whether investment- or wire-mesh, rolled, wrought, vacuum melted or air melted, there's a Haynes high-temperature alloy to meet your needs.

Address inquiries to Haynes Electric Company, 270 Park Avenue, New York 17, N. Y.



Engineers discuss double wall test section of space glider skin with a honeycomb carbon panel made of Haynes alloy No. 25, designed to withstand stresses lost at re-entry.

HAYNES
ALLOYS

HAYNES STELLITE COMPANY

Division of Union Carbide Corporation

Kelowna, Indiana

UNION
CARBIDE

Haynes and *Union Carbide* are registered trade-marks of Union Carbide Corporation

Washington Roundup

Sylvester's Censorship

Arthur Sylvester, assistant defense secretary for public affairs, told a Senate Armed Services subcommittee investigating armament of military officers that he thinks the Defense Department has been "quite successful" in the past year in perfecting sensitive information. He gave four examples: "We have controlled disclosure of information about intelligence gathering activities. We have kept secret details of missile fittings which occur in remote areas in order to give intelligence agents time to stop development on these weapons. Where possible we have prohibited closing photographs of our warplanes after refueling and supporting facilities to prevent an enemy from making specific analysis from photographs. We do not announce when important weapon systems tests will be held to preclude an enemy from intercepting reconnaissance to gather data from our flights."

Defense Secretary Robert McNamara used the question of the privilege of the executive branch to deny information to Congress and said he did not want individual members called to explain why they revealed military secrets. Subcommittee Chairman John Stennis said he did not see how a disclosure on executive privilege could be avoided but he was to meet with McNamara last weekend to discuss it.

LeMay's Recuperation

Air Force Chief of Staff Gen. Curtis E. LeMay, whose three-week rest trip to Hawaii ended last week, was the first of USAF's budget testimony before Congress, in due to return to the Pentagon by that week. Defense Department and his physicians advised a rest to complete recovery from an attack of influenza and a virus infection.

John A. McCone was confirmed by the Senate as director of the Central Intelligence Agency last week by a 71 to 12 vote after three days of debate. Sen. J. William Fulbright, chairman of the Senate Foreign Relations Committee, said the appointment which extended until McCone's retirement of more than 5½ million of stock in Standard Oil of California which has relationships with the governments of Arab and African in one of four participants in Arab-American Oil Co. (Amoco). Sen. Stuart Symington led the support for McCone, who served as under secretary at the Air Force when Symington was Air Force secretary during the Truman Administration. McCone also was Atomic Energy Commission chairman under the Eisenhower Administration.

While House is deeply involved in the struggle of decision concerning the development of a tactical fighter (TFX) for use by Navy and Air Force (see p. 25).

Soviet Submarines

Soviet Russia now has five nuclear-powered submarines, compared with three in mid-1961 (AW June 15, p. 20) in addition to conventionally-powered submarines which are three times from the surface. Adm. George W. Anderson, chief of naval operations, told the Senate Armed Services Committee that these surface-based vessels have a range of 500 mi. Air Force commandant about East Coast Strategic Air Command missile and air bases but made strong representation to the Joint Chiefs of Staff that Navy's anti-submarine warfare effort is not being pushed hard enough. As a result, Adm. Anderson has forced a task force of 10 officers and civilian to make an assessment of the need for.

Prospects for any modification of the Resegulation Act appear dim in view of the Administration's report to Congress for a four-year extension beyond June 30. American Industries Army will also seek an amendment authorizing the U. S. Court of Appeals to review U. S. Tax Court decisions on tax matters.

Chairman Warren G. Magnuson, concerned over the defense financial problems, plans to have his Senate Commerce Antitrust subcommittee hold hearings this spring and perhaps recommend legislation. No date has been set.

Army Missile Future

Future of large Army-developed missiles continues to be somewhat doubtful. Gen. J. Lamm, assistant Army secretary for research and development, watched the firing of an Army-Martin Pegasus at Cape Canaveral Fla., recently. He said there is a "major heart" in its potential range of about 400 mi. He said there have been studies of a longer-range version, but that no research and development money has been spent on this. He concluded there is still a question of "credibility" between Army and Air Force on missile range, but he did not see the Pegasus as the last of the larger or major Army missiles, even though Army has demanded its Ballistic Missile Agency.

LeMay Research Center will direct the Apollo lunar landing propulsion system, a job that Marshall Space Flight Center had been expected to get and probably will direct all spacecraft propulsion.

Senate Permanent Investigating Subcommittee expects to schedule public hearings on earnings of aerospace contractors within a month.

Engineers at the first U. S. artificial satellite, passed its fourth birthday in orbit Jan. 31 with a life expectancy of one to three more years. (Space 1 1981 ml and page 217 on)

—Washington Staff

AVIATION WEEK and State Bicentennial, January 5, 1968

12:22 p.m. The threat the base of Rangoon toward the moon through two paths and one true maneuver.

At 12:45 p.m. in the 1st hour, the defense counter was launched. At 13:45 p.m. the non-directional antenna on top of the spacecraft moved out at a 45 deg. angle. At 12:52 p.m. the voice data came, which had arrived in 30 min. began to take pictures and attempt to make them through the high-gain antenna, which was to send scientific data to earth.

After the first slight pitch required to position Rangoon's base toward the moon, the high-gain antenna was to rotate 2 deg. to look at earth. Instead of stopping at the end of the 2 deg. turn, it went too far. Cause is not known. The antenna's movement is controlled by a computer program and guidance, but an override command telling it to bring in a new period for JPL test this command had not yet arrived. The high-gain antenna had not only at an 16 deg. angle of elevation, was carrying signals from the side lobe of the antenna.

The field of reception at Goldstone was a signal strength of -130 DBM and a signal strength of at least -115 DBM from Rangoon. Its good reception of the TV pictures. Before the several minutes were made, signal strength had been -113 but afterwards it dropped to -130, a decrease by a factor of 10,000.

In the 45 min. time span of the TV experiment until Rangoon left Goldstone's tracking horizon at 1:11 a.m., JPL received from the high-gain antenna such as sending scientific data to the communication system, which was sending engineering data but the non-directional antenna was not a person that the spacecraft itself in the way of the signals.

JPL is considering the use of a pointing and scientific receiver and by the non-directional antenna as a low gain. Since both received in the omnidirectional antenna after the TV experiment, but the data receiver was off all but the forward channels. With the voice guidance not essential to the use, no voice power was available and the other two buttons were failed.

No attempt was made to account for the spacecraft. At 5:11 p.m. EST on Jan. 7, 1970, at 5:11 p.m. EST after launch, Rangoon came in close approach to the moon—22,862 m—at a velocity of 6,158 mph, and passed into a heliocentric orbit (see page 30).

Rangoon 3 is launched directly, but at 1 a.m. EST on Jan. 12, when it was 194,000 km from earth, it was still being tracked by the apogee pickup as it flew the small, high-gain transmitter when it is powered toward earth. This is powered by an silver cadmium battery whose life is expected to be no more than 70 days.

Department of Defense Restricts Nike Zeus Testing Information

Public information plan developed for the guidance of U.S. Army, Air Force and Navy during the initial development phase of the Army's Nike Zeus anti-missile missile system is being approved by ICBM launch target vehicle, scheduled to begin this year over Pacific Missile Range, is projected to give basic information of life cycle, plus other details already known.

These Nike Zeus launch data, known as the Nike Zeus launch data, are being used by the Department of Defense to develop the Army's anti-missile missile system. The information is being used to develop the Army's anti-missile missile system. The information is being used to develop the Army's anti-missile missile system.

The information is being used to develop the Army's anti-missile missile system. The information is being used to develop the Army's anti-missile missile system. The information is being used to develop the Army's anti-missile missile system.

Army Role

All 47 intercept tests will be conducted in accordance with Army specifications as part of the program to develop and collect the Nike Zeus system. Army will specify the time of the launch, the trajectory, the altitude, the rate of turn, and the rate of turn. The information is being used to develop the Army's anti-missile missile system.

Policy outlined in the public information plan is that demonstrated capability of the U.S. to intercept ICBM target vehicles is of paramount military and political importance, and that information relating to this capability must be carefully protected. Also, degradation of information about the system is the detriment of the U.S. would be detrimental to national security.

Accordingly, preparation of information plan proposed to follow concerning the test is intended to follow these guidelines:

• Information will be completely objective and avoid references which can be interpreted as divulging other Nike

Zeus on the target vehicle's ICBM launch, because such degradation would be detrimental to the national interest.

• Target vehicles will be described in detail, but not in terms of specific ICBM.

• Test equipment will be described in general, but not in terms of specific equipment. The information concerning will be presented as development data to demonstrate the capability of the Nike Zeus anti-missile missile system, and not be presented in context between Nike Zeus and specific ICBMs.

Secrecy on Interception

Under the broad information guidelines, however, all things in the program for Nike Zeus interception of ICBM launch target vehicles will be described in detail. These data will not be released in advance. Test results will be withheld.

Department of Defense will be responsible for clearance and release of all information relating to the program, but the Army, since it has specific expertise in the intercept test program, generally will be responsible for the preparation and coordination of information.

Both Air Force and Navy will have been limited solely in release of information.

The series of tests will be divided into two major phases. The first phase, the 35 ICBM launch tests, will be initiated by an announcement by the President of the United States. Under this plan, release of information will be made on the day of the test. The Army will be responsible for determining whether the performance of the target vehicle permitted a complete offensive defensive engagement at Kwajalein Island.

President's Statement

At the completion of Phase I tests, the president's statement is to be made by the President's statement to include the following:

"The U.S. has made the first interception of an intercontinental ballistic missile on one occasion to become. This is a major step forward in developing this country's ability to defend itself and its most important, in providing such aid."

"The U.S. Army's Nike Zeus anti-missile missile system successfully intercepted an ICBM launch on a par with the data on the test conducted on the Pacific Missile Range."

"The Nike Zeus installation and its



will be launched from its base at the Kwajalein Island, South Pacific. The intercepting missile will be launched from the central antenna bays. Antenna bay, present upon the central antenna is carried forward of the target at low Mach number and at a high Mach number. The intercepting missile will be launched from the target at low Mach number and at a high Mach number. The intercepting missile will be launched from the target at low Mach number and at a high Mach number.

Nike Zeus missile, fired and controlled from Kwajalein Island, scored a direct hit.

"The ICBM now came in a target vehicle which had been launched into an ICBM trajectory at ICBM speed from an ICBM launch in the Air Force at Vandenberg AFB, Calif."

"The intercept was conducted with extreme precision, including successful interception of the target vehicle at Kwajalein Island."

Orbital Launch Study

Results of a study of orbital launch and launch of space vehicles known as orbital launch system (OLS) (AW 12-12-70) and AW 30-12-70, as directed by Vought Aerospace Co. National Aeronautics and Space Administration has been presented to Marshall Space Flight Center.

Company studies Vought with a launch data was American Missile & Rocket Co. and the launch data was American Missile & Rocket Co. and the launch data was American Missile & Rocket Co.

"The Army and ground control (agencies) and a launch data was carried in the target now test indicated that the Zeus missile was not within the kill radius of its target. A test conducted from Kwajalein Island and the altitude at which the intercept took place were not disclosed."

The next ICBM test, also had been beneficial to ICBM velocity on a 5,000-mile trajectory from Vandenberg AFB, Calif. using an ICBM-type ICBM launch from a launch site on a test of the Strategic Air Command.

"Testing of the Zeus system using ICBM now came through in its nature on the Pacific Missile Range."

"The target now came against defense planners' best technical prediction on future course. Targets in the future course were not within the kill radius of its target. A test conducted from Kwajalein Island and the altitude at which the intercept took place were not disclosed."

Basic Situation

The public information plan anticipates that for basic information, may be done the intercept test. The situation is:

- Complete engagement, with successful interception.
- Complete engagement, with no intercept.
- No engagement, because of target vehicle failure. In this case, the Army, at Kwajalein, will inform the Air Force, at Vandenberg AFB, of the situation, and the latter, during Phase 2 tests, will prepare and coordinate a statement with the Army prior to submission to the national situation of defense is declining, in which.
- No engagement, because of target vehicle failure. In this case, the Army, at Kwajalein, will inform the Air Force, at Vandenberg AFB, of the situation, and the latter, during Phase 2 tests, will prepare and coordinate a statement with the Army prior to submission to the national situation of defense is declining, in which.
- No engagement, because of target vehicle failure. In this case, the Army, at Kwajalein, will inform the Air Force, at Vandenberg AFB, of the situation, and the latter, during Phase 2 tests, will prepare and coordinate a statement with the Army prior to submission to the national situation of defense is declining, in which.

Contract Awards

Washington—Vought recently awarded a \$50,745,000 contract to United Aircraft Corp.'s Pratt & Whitney Division for the F-105, F-106 and F-107 aircraft engines for the Air Force. Work will be performed in Fort Belvoir, Colo.

- Other recent contracts included:
- A \$40 million contract for 820 units to North American Aviation Inc. for research and development on the Minuteman missile guidance and control system. Work will be done in Downers, Colo.
- A \$34.4 million Air Force award to Lockheed Aircraft Corp. for research and development on space utility vehicles. Work will be performed in Huntington, Calif.

AIR TRANSPORT

French Press Super Caravelle Decision

British are advised they will lose out to U. S. engine if cooperative agreement is not reached soon.

By Herbert J. Coleman

London—French government has informally told British aircraft designers and engine manufacturers that unless a United Kingdom decision on joint supersonic transport cooperation is made soon, the engine probably will come from the United States.

The aircraft involved is the Sud Super Caravelle which, if the joint agreement is reached, will be built by Sud and British Aircraft Corp. The French have committed the industry to a Mach 2.2 transport by 1966-67, but the British government has not yet given its indication the final go-ahead.

Prime engine under consideration is the Bristol Siddeley Olympus 591, a civil version of the Olympus 593 for the TSR-2 strike fighter slightly modified for the supersonic transport. However, Rolls-Royce has designed the RB173 engine—also as the 28,000-lb.-thrust class of the Olympus 593—for the same project.

Flight Tests

Bristol Siddeley has the edge, since the Olympus has been in Royal Air Force service for more than a year, and the 597 model is scheduled to start flight tests in an Avon Vulcan this month at Bristol. The engine is being tested in the fully service, with two pods for engine air being forward of the prop rotors. Another 75 is on static testing. No aerial has been run for the RB173.

With the final decision resting at the British cabinet level, the French

have held industry concerns in line that supersonic transport designers are considering a version of the Pratt & Whitney J75 jet engine, modified somewhat from its present use in the Republic F105. The deal would be completed through an ownership agreement between Pratt & Whitney and SNECMA, the French engine company.

Dr. Stanley Hooker, Bristol Siddeley chief technical director, said the Olympus modification includes blade cooling and, most important, air after burning system fully controlled by pilot throttle. The latter was designed into the engine to give it thrust-to-weight of 18,000 lb. to reduce nose boom loads. The engine will cruise at 58,000-60,000 ft.

The supersonic version also includes a complicated system of variable geometry and boundary layer control,

still in the process of design, to provide a secondary airflow.

Three curves is needed to fit in the F105, but with four damaged doors, fitting the model. State tests are centered on heating the intake to 1400°C to simulate Mach 2.2 flight at altitude.

Dr. Hooker and the airplane probably will be offered in two engine forms, one British and one French, which extremely would be about identical. The British version would be used for transatlantic and Commonwealth flights and would consume payload fuel fast, while the French are heavily interested in medium range flights. Both versions would use four engines. Hooker hopes a market for 100-plus airplanes.

RB53 Design

Meanwhile, Hooker and Bristol Siddeley are putting design of plasma chamber burning for the RB53 Pegasus family of jet engines. The powerplant is now used in the Hunter P1127 VTOL fighter and has been submitted in the NATO competition as the engine for the F119 supersonic version and the Republic F105. The engine is the RB10 (AW Dec 18, p. 28). The engine has not yet been built.

Plasma chamber burning involves burning outside fuel in the front nozzle ducts containing the burner air. Air in the engine is already cold and large thrust boost can be obtained on the order of 30% on takeoff and nearly

double at Mach 3—with a small increase in specific fuel consumption. Bristol Siddeley has done considerable research in this field in its jet engine design studies.

Pegasus also is being equipped with water injection which comes with operation when exhaust nozzles exceed a certain angle from the horizon. With water injection, Pegasus could thrust at sea level as well as attain full ISA performance in subsonic transonicity up to M2.

Dr. Hooker considered the P1127, now in flight test (AW Jan 15, p. 31) now has range better than the Royal Air Force's Hunter. Hooker will test the climb capability, without considering its performance in a post-VTOL support.

Other Engines

Another Bristol Siddeley engine designed for use in tandem with the RB53 is the RB59 pure jet engine, which should enter test next summer (AW Dec 28, p. 11). The engine currently is being built for use with a light transport design, which Hooker describes as about the size of the Conquest, with two RB59s in tandem. The RB59s would be mounted in the belly of the cockpit section.

Concentration on gas lift is a risk, particularly for Bristol Siddeley, since at present no other engine manufacturer has gas lift engines. Hooker is on record as discussing gas lift engines which would be used for propulsion engines like the one in the Conquest (AW Dec 21, p. 77).

But Dr. Hooker says that, while the gas lift engines would be used for propulsion, the gas lift transport would be used for transport. The gas lift engines would be used for propulsion, the gas lift transport would be used for transport. The gas lift engines would be used for propulsion, the gas lift transport would be used for transport.

Brecher Resigns

New York—Edward Brecher has resigned as a voting trustee of the 5500 Hughes Hotel in Times World, New York, to be succeeded by Theodore V. Hunter, former chairman of Suez Canal and Co.

A statement in Brecher has been sought for some time (AW Jan. 29, p. 41). Brecher remains board chairman of TWA. Brecher will be joined in December, 1965, to become a TWA director if elected and shortly thereafter expected to become a voting trustee, but made it clear he would expect to be replaced in time with a reasonable time.

TWA and it was not unusual of Brecher resignation and Hunter's appointment to the Brecher Trust Co., representing the voting trusteeship, responsible for the voting trusteeship.

Personalities Outweigh Issues In National-Continental Merger End

New York—Whetherhead of the Continental and National airlines merger proposal last week basically resulted from the inability of National's Board Chairman George T. Baker to bring himself to sign an agreement to end the crisis of his airline.

No explanation of the step was made by either airline except that they had been unable to complete a definitive agreement on merger terms. The two airlines had made an agreement in principle, and had filed an application with the Civil Aeronautics Board (AW Dec 15, p. 71).

Continental, which was to be the acquiring carrier, had proceeded quickly with the drawing of the definitive agreement.

Continental felt that the interests of both parties, as outlined in their talks last week, resulted in the final decision. Baker, however, began to have second thoughts on the plan and to question whether Continental's interests were being adequately protected in his judgment.

However, some, this objection was, Baker was unable to bring himself to take steps to a lesser of a plan that might well have been an irreversible step.

Somebody disagreed strongly with this view. Secretary Baker said that, although in the business not lost, affected the decision, but always was not overlooking that National's managers and not his, himself, would be in charge of the National's management.

All unions agree, however that per month plan, a much more domestic sale in the merger breakdown than any part of the.

The National union, which Baker had previously spoken at in the board meeting, meeting and ownership of National and how that in the final agreement to have carried the burden of the merger.

Until the professional managers explain the individuals of airlines this union, commented, there will be little of any actual merging on a solid business basis. As in the past, he said, it will take great common sense to force the way.

When the merger broke down, there was some consideration on the part of the two airlines to pick out a potentially controversial point and to explain the surprise move. But in the end, they felt that might be too transparent and decided to explain as nothing.

One result of the breakdown now might be to force what had become

dominant interest in a Continental-Baker merger, sources here speculated. Baker, who says National has no need to merge, adds that National is not discussing merger outside with any carrier.

They had been some early speculation that the two airlines might have withdrawn their proposal in order to see what interest by merger the CAB might have shown in the Eastern Airlines merger.

The two airlines asked CAB to deny their application, which was filed Dec. 12 in the form of an aerial agreement and was expected to receive an official treatment by CAB. Under the agreement, Baker was to become board chairman of the combined "National Continental Airlines." Continental President Robert T. Smith was to become president of the combined National & T. Weiland was to become first vice president and assistant to the chairman of the board. There was some speculation that final agreement on the responsibility of this step difficult in the combined operation was not forthcoming.

Surprise Move

This move came as a surprise to the airlines. For one thing, application of American Airlines to merge with Continental if it were approved, would leave Continental and National in similar position individually, thus in a combined union. As Eastern Airlines contribution would provide more powerful control, National would have a much more powerful and aggressive Continental in its Chicago West Coast sector.

Both National and Continental showed financial results in the third quarter report. Continental ended a net profit of \$1,127,000 for 1964 on gross revenues of \$62,996,000. Operating profit was \$4,923,000. Excluding capital gains, it was Continental's second best year since 1959, being 1960 when net excluding capital gains totaled \$1,265,000 on gross revenues of \$61,847,000.

National showed a net profit of \$227,133 for the nine months ended Dec. 31, 1964, compared with a net loss of \$4,828,205 for the like period of 1960. Operating revenues for the 1961 period, boosted by Southern Transcontinental route traffic, totaled \$48,076,694, an increase of 17% over the 1960 figure. For the 1961 period operating losses to \$48,473,000. Net profit for December 1964 was \$791,146 compared with a net profit of \$249,902 in December, 1960.



Boeing Rolls Out First 707-320B Turboprop Jetliner

First 707-320B turboprop jetliner rolled out from Boeing Co. factory at Boeing, Wash., recently to begin Federal Aviation Agency certification tests. Aircraft is one of five ordered by Pan American World Airways. First three production models will be used in the FAA test program. Twin World, Lufthansa and Air France also have ordered the 707-320B.

MacIntyre Confident of Merger Success

By L. I. Doby

Miami, Fla.—Fall confidence that the proposed Eastern Air Lines-Venezuela Airlines merger will be an accomplished fact by November and not perpetually further argued that could soften the number of dissenting trustees to four as it was expressed here by Malcolm A. MacIntyre, Eastern's president.

The proposed union of two of the industry's "Big Four" members has been assured repeatedly, promising by the Civil Aeronautics Board, Bureau of Customs, and much of the consensus that would effect merger announcement has solidified.

MacIntyre said that early congressional action was probably the result of a "nice between rivals and ease of mind," and added that he had had several talks on the subject with a number of congressmen who initially had felt the merger would create too large an organization.

Fits CAB Position

MacIntyre said he believes that the proposed combination fits perfectly into the merger philosophy advanced by CAB Chairman Alan S. Bond. He said it will strengthen the financial position and eliminate "size-over-capacity," and emphasized that the merger will not reduce present competition.

He stressed that there are no plans to drop major divisions from the new board seats and he'd be confident in

growth in this air shuttle principle. He emphasized the air shuttle operation between Boston-New York-Washington is "profitable," and said that final Eastern votes are in the mid-90s. As long as proved profitable during summer months and "marginal" in the winter, he said, he felt air lines have about as long as they can get

History of Talks

MacIntyre disclosed that talks between American and Eastern on the merger began about the first of December. He said that Eastern previously had explored other merger possibilities. Private purpose behind the drive for a merger is the low rate of return going back to the airline industry under its present structure. MacIntyre said that Eastern is in a sound financial condition and has "saturated the market" as far as losses are concerned will be "back in the black" this year.

He said that without an adequate rate of return, even though some profit is achieved, the normal growth is impossible. He cited the industry leaders in an example, saying that its biggest problem has been finding capital to support the purchase of modern equipment. He said he will not be asked to fund capital in the next 10 years through the job of stock.

He stated that Eastern is now increasing the number of seat miles offered but that the growing cost of producing the additional seat miles is eating into the carrier's rate of return. "Our prod-

uct is seat miles," he said and added that one purpose of the merger is to generate more seat miles at less cost which will result in substantial savings in cost.

Other for the Boeing 727 turboprop transport by both American and Eastern will be reduced, MacIntyre said, although he was unable to specify the exact amount of the cutback. He said the combined company will also be able to reduce orders for engines and spare parts, but that Eastern's maintenance base here and American's in Tulsa will be retained.

Private issues, particularly the Lockheed 3499 Constellation and the Douglas DC-9 will be eliminated. He admitted that the market for these aircraft is limited, but said that disposal of the aircraft will cause losses since all of American's DC-9s had been written off and Eastern's Constellation aircraft were about entirely depreciated.

Ground facilities at stations served jointly by the two carriers will be consolidated, and the company also, though MacIntyre felt that the two terminal buildings at New York International Airport will be retained because of the need for gate space there. He indicated that one terminal would be used for regular flights and the other for air shuttle flights, or that one would be called "American West" and the other "American South."

Name Choice Explained

He refused to agree that Eastern is being absorbed or subsumed by American, and indicated that Eastern will have an equal share in policy making for the combined company. The name American was chosen for the new company, he said, because use of the name Eastern, either by itself or supplemented with American, would imply a regional operation.

Four or five Eastern officials will be invited immediately to accept key positions at the newly formed organization, he said. Captain E. V. Roberts, Eastern's former president and Eastern's current board chairman, will retire, MacIntyre said.

He felt that more arguments will be stimulated by the Eastern-American union, with the result that only four or five trackable will remain in existence. Regional services will be taken over by the local service carriers, several of which, he said, have already taken on a regional character while still performing feeder-line routes.

It will also take time to measure the degree of opposition which will emerge during CAB hearings. In the case, he said, Airline Week talks with officials of

other carriers indicate that it will be extensive. The fact that two of the nation's strongest airlines have elected to merge caught the industry off guard since it was the least expected of possible merger partners and the full reaction has not yet been expressed.

Ideal Mergers Concept

The popular concept of the ideal merger has been the absorption of a weak carrier by a strong carrier, as in the case of the Capital United merger to create a single strong airline without affecting basic competitors of competition. Mergers of two or three airlines have been favored since prior to the Trans-Northwest discussions. American's president, C. R. Smith, said that combining "carriers with financial aid and lacking resources to further the strong inherent in an merger will not serve to strengthen the carrier's themselves at the industry."

Neither MacIntyre nor Smith planned to oppose the new draft Civil Aeronautics merger plans.

Link, if any consolidation, however, had been given to the possibility of a merger between two large and four or six strong airlines. Early reports of the Eastern-Venezuela merger also discussed that spread were riddled with skepticism.

Public announcement of the merger last month (Jan. 28, p. 36) was accompanied by general feeling that the Board would approve the creation of so large an organization. "That didn't seem like a very big deal," he said. The merger can be expected to become more attractive as the base for CAB hearings grows closer.

Target date for the merger is November. Because CAB hearings for the Civil Aeronautics Board are scheduled to begin on the 10th of November, he said, the merger must be completed before Jan. 20. In announcing its stand on the merger, Eastern stated the following viewpoint.

"The best hope for achieving a sound industry of air transportation capable of standing up to increasing costs and demand toward higher fares and charges for the public lies in permission to restructure, stronger, more profitable, more efficient, more competitive, with much more competitive balance while permitting elimination of costly overproduction and overduplication both in the air and on the ground."

A letter from Eastern Airlines, MacIntyre said that industry problems such as unbalanced earnings, inefficient traffic and overproduction problems for Eastern "because we have more competition than ever before." He said that cooperation has become stronger with the Capital-Capital merger and will become even stronger with other mergers "here to follow."

North Atlantic Traffic—1961

New York-North Atlantic scheduled traffic cleared on improvement during the last quarter of 1961 with a 13% increase over the same period of 1960 to a 1961 quarter total of 104,719 passengers. Capacity for the quarter was up 24% to 108,992 seats.

For both for the year illustrated the total excess of capacity on the route was a total of 17,075 seats.

Over all load factor on the North Atlantic is both direction for 1961 was 53% down from 64% in 1960. Individual load factors ranged from a high of 79% (South Atlantic) to a low of 11% (Rome).

Passenger traffic declined significantly in 1961 dropping 21% to a total of 244,179 passengers. Economy-class passengers totaled 167,456, up from 154,550 in 1960, and first class passengers at 166,723. The 1960 total, divided 222,872 and 222,872 and 997,104 weekend passengers. Load factor was 104,719 and weekend load factor was 130,244.

Airline	Seats	Passenger	Load factor
Air France	13,810	14,719	86%
Air India	46,274	14,719	32%
Alitalia	104,942	66,738	51%
BOLAC	51,035	21,611	33%
Canadian Pacific	75,605	35,354	46%
DL	75,152	42,797	56%
KL	34,146	33,725	91%
KLM	15,341	49,787	32%
Lufthansa	298,577	175,132	51%
Pan Am	219,714	121,274	56%
Qantas	81,614	9,942	51%
Swire	157,146	6,662	4%
VIA	799,419	113,871	14%
Western	151,805	71,936	46%
Trans-Canada	117,298	104,821	87%
TWA	42,872	20,718	46%
Totals	5,717,412	1,909,466	31%

Note: Pakistan International Airlines figures not available.

TWA Caravelle Order Deadline Is Extended

New York—Deadline for Trans World Airlines decision whether or not to buy the Sud Caravelle has been extended until May and the airline now allows a 30-day extension for the possible purchase of 727 derivatives, jets which could displace the Caravelles.

The Caravelle order, placed last September, on contract for TWA is financing the purchase through sale of additional common stock. Such financing has not yet appeared desirable or feasible, TWA and because of the depressed market for airline securities.

While the first agreement has been reached with Boeing, substitution of size 727s for aircraft in TWA's current order of 25 Caravelles 330s and 1200s appears possible. Part of 20 1200s is now scheduled for delivery in April and the first of 727s is scheduled for delivery next fall.

The Caravelle order, while still quite possible, appears to have a dimmer chance of delivery in view of the nego-

tations with Boeing. Sud has canceled some subcontracts in connection with the TWA account.

The Caravelle, one of the major assets being the airline delivers available for the Caravelle than the 727.

Air France, Avianca Sign Pool Agreement

Profitable service between Europe and South America is being offered under a new agreement between Air France and Avianca, the Colombian airline.

The current will operate six weekly flights in each direction, dividing the schedule between Air France's Boeing 707-320s and Avianca's Boeing 720Bs. Computations of ground facilities and sales operation also is provided under the agreement.

The Colombian carrier's flights will operate between Lima and Frankfurt with service to several intermediate points.

Air France's schedules will operate between Paris and Lima, also serving other points.

Iberia's Top Officer Replaced

Madrid—Jose Maria Luis (Jules) Rubio, commander of Spain's air defense system, is stepping in as acting chairman and permanent vice chairman of Iberia Airlines in a first step toward the predicted top management change of the national flag carrier.

Rubio, who has been a member of the 12-man board of directors, was named to his new position at a recent meeting of the directors which at the same time accepted the resignation of former chairman and president, Tomas Delgado y Torres de Alca. Resignation of Delgado, a former president of the International Air Transport Association, and a general staff in Iberia's assigned structure was predicted by Aviation Week in its Jan. 8 issue (p. 16).

An Iberia spokesman said last week that Rubio will serve as acting chairman until a permanent replacement for Delgado can be found and formally elected by the board.

The personnel will not be possible until the board itself is largely changed. Iberia's National Air Institute (INA), the marketing agency for the airline, is expected to ask for the resignation of the entire board in response to a request by the Franco government. At the latest board meeting, however, the remaining members, including General Manager-Capt. General Lopez, were asked by INA representatives to accept their posts until further notice. The company believes that INA plans to replace the members on a step-by-step basis rather than all at one time.

Although the board usually meets on a once-a-month basis and sometimes plans for its next session at the close of the previous one, there were no such indications this time. The date for the next meeting apparently will be set only after it is requested by INA and when further changes by that body have been decided upon.

Communist Threat Is Big Factor In Decision on LACSA Control

The Wind Wright

Washington—Pan American World Airways' control of Costa Rica's flag carrier, although declared illegal by the Civil Aeronautics Board, has been approved after State and Defense depart-ments expressed fear the airline might fall into the hands of Soviet Russia or another Communist country.

CAB noted, however, that it did not confirm Pan American's pricing model of the online-LACSA—without prior Board approval, as required by the Federal Aviation Act. But, CAB said, it considered matters of national defense to take precedence and approved the control subject to strict conditions.

The Board's approval reversed two prior decisions—one in 1955 and another in 1957—by its own committee. In both decisions, the committee had disapproved the control on grounds that it was inconsistent with Board policy, calling for gradual elimination of interest held by U.S. citizens in foreign banks which operate in competition with other U.S. banks.

The committee concluded that the adverse effects of continued control of LACSA by Pan American outweighed the public benefits. It said the control could lead to U.S. mail po, finding its way into the hands of a foreign carrier, the U.S. becoming embroiled in struggles between the national interests of Central American countries and relations of interest with Pan Americans. It also said LACSA was a healthy, mature airline and would not be harmed by competition.

American's Earnings

Airways' Audley net earnings in 1961 totaled \$8,375,000, including \$1,254,000 in profit from property and equipment sales. In 1960, the net earnings figure was \$11,733,000 including \$1,744,000 in net profit from equipment

Revenues for 1981 totaled \$423,167,000, down from \$426,482,292 in 1980. Expenses for 1981 totaled \$415,703,422, down from \$418,441,366 in 1980. Revenue passenger mile total was down from 5,084,999,260 to 4,297,600,493 while freight ton miles increased from 115,164,909 in 1980 to 123,491,292 in 1981.

In another pertinent report, *Forrest* estimated its net 1961 income at \$4,179,000, up from \$376,000 in 1959. Passenger mile total increased 3.4%, but passenger revenues rose only 1.82%, reflecting the shift from first class to coach.

to affiliate with another animal if Pan Americans called out.

Testimony by the State and Defense departments indicated that any action weakening LACSA and paving the way for possible control by an unfriendly power would have adverse effects on national security. CAA decided to appear as the central subject in the following conditions:

• **CAD will have the right to review or revoke its present approval** after notice, and hearing. Or, after hearing Pan American's views, it can amend, modify, or revoke any of the conditions of its approval.

*Pan American must file quarterly reports showing volume of interline traffic exchanged between Pan American and LACSA, traffic sold for LACSA by Pan American as its general agent, along with an account of origin and destination of passengers and an itemized list of expenses shared by Pan American and LACSA.

Annual reports must be filed showing gross amount of all transactions between the two owners with a note indicating C&B where such amounts in. kept. All records regarding transactions must be available to C&B's New York representatives upon request.

*Free Americans can not use LAGSAY's lower rates as an excuse to file far rates lower than IATA standards, without CAB approval.

* Both authors are forbidden from using the same public relations staff or jointly served by LACSA in the U.S. lifetime had joint sales may be handled in with any two unrelated persons.

Flights may not be identified with those of Pan American.

- Pan American must relocate its traffic and take personnel as to the independence of LACSA as a Costa Rican flag carrier
- Separate telephone facilities must be

maintained at points agreed by both owners in the U.S. to preserve their individual identities. If organic telephone service is not established, Pan American must file a detailed statement with CAB telling how, separately, identity

* **Changeable** register space, personnel, advertising, signs, posters, and literature must be submitted at least 45 days prior to the start of the event. LACS may or may not be able to accommodate last-minute changes.

Pat Amey was asked to help form LACSA in 1964 by a group of Costa Rican citizens. Originally, Pat Amey owned about 40% of LACSA.

Airlines' On-Time Record

Following is the Navigator record of on-time performance by triathlon, according to reports filed with the Civil Aeronautics Board, showing the percentage of nonstop and one-stop flights arriving on time or within 15 min of schedule.

Eastern	87.0%
Northeast	84.0
South	81.4
National	80.0
TWA	79.0
American	77.1
United	76.4
Continental	68.9
Western	68.6
Northwest	66.3
Delta	63.6

LACSA dropped to about one-third, however. Fin America has continued control with its majority ownership through a creditor-debtor relationship, participation in management and various contracts.

Eastern Defends Its N.Y.-Miami Shuttle

Washington—Eastern Air Lines Inc. has announced changes by National and Northwest airlines that its proposed New York-Miami jet shuttle service (AWW, 11 p. 36) would not succeed in attracting traffic from there during the peak of the tourist season.

Eastern and the \$75 distance fee, and \$87 night fee—a \$10 saving in cost—was in line with the reduced take of the service. Eastern said the difference between shuttle service and the regular jet coach service was the shuttle savings; it could not make a nonstop

National and Northeast, both of which have filed defensive New York claims yet deny, and the reduction was on par for the first defendant to move. National told Eastern that the bottle service in Northeastern U.S. is a consumer market where the New York courts should not be involved.

National used a 500-line message wall as an important factor to a vaccine.

IL-18-1 Performance

18-1, which was the entire center wing section, as a fuel tank (AWF Nov. 20, p. 34), is said to be identical with earlier B-15s in outward appearance.

11-18-1 Performance

Moscow—Experiments on the B-15 tailhook transport has flown the Trans-Siberian Moscow-Vladivostok route in 11 hr 15 min nonstop, indicating that the craft's range is over 4,800 mi. at 400 mph or better cruising speed. The B-15, which uses the retract outer wing sections as a fuel tank (AW Nov. 20, p. 32), is said to be identical with earlier B-15s in structural components.

Airport Traffic Funds Total \$183 Million

states, reflect to a degree that state's population and growth rate. Thus, the five states scheduled to receive the most federal money under FY 1962 grants are California, \$7,021,996 for 70 projects; Illinois, \$6,117,191 for 20 projects; New York, \$5,125,081 for 10 projects; Alaska, \$3,991,912 for 10 projects; and Alaska, \$5,475,186 for 18 projects.

Included in the \$310 million earmarked for new ATC facilities is about \$475 million for new ILR facilities which will partly improve the capability of 18 U.S. airports to cope with Instrument Flight Rule traffic. Under the Federal 1962 program, an initial ILR facility will be installed at Andrews AFB Md., Champaign IL, Lake Charles La, Lancaster Pa, Concord

Calif., Fayetteville, N. C., Oxnard,
Calif., and San Diego (California),
Calif.

Second ILS installations are slated for Charleston, S.C.; Midway, W.V.; Charleston, W. Va.; Dallas, Tex.; Nashvile, Tenn.; Tulsa, Okla.; Williamsburg, Va.; and Wombat Lacks (Marshall) Co., Ala. An ILS venture without grade slope also will be installed at Charlotte, N.C. Va., and Indianapolis, Ind.

The high rest of an automatic ATC system based upon radar and beacon transponders is underwritten by the approximately \$5.6 million FAA will spend simply to make 15 existing airport surveillance radars (ASRs) capable of receiving non-precise returns from transponder-equipped aircraft.

Major FY 1962 Air Traffic Control Projects

Item	Location	Amount Unit Cost
Long range radar (ASR)	Fort Rucker City, Ala	ARJCC
Terminal surveillance radar (ASR)	Redford, Mass Jackson, Miss. Oakland, Calif.	
Long range radar modifications to existing equipment	35 cities	\$897,401
Construction of ASR to radar base on reception	35 airports	\$129,600
Air route buffer control center building	San Juan, Puerto Rico	\$2,067,000
Airport towers	Red Red Field, Dallas, Tex New Lake Charles, La. Airport Seattle	\$160,000
Vor/DME stations	53 cities including Tulsa, Okla.	\$702,000
Extended VORs	21 cities	\$115,800
Extension of Vor/DME and VORs	9 cities	\$136,800
New ILS installations	15 cities, including second systems for 5 cities	\$263,000
Reduced ILS facilities	30 airports	\$63,200
Addition of ILS directional facilities	14 airports	\$153,700
High altitude approach lights with crosswind	36 airports	\$103,400
Visual glide slopes	35 airports	\$51,000
Direction finding equipment	90 airports	\$27,500
Flight service stations	MacArthur Field, Bk. E. I.	\$364,994
Flight service station expansion	13 stations	\$217,000
Construction and equipment for expanded automated flight service stations	MacArthur Field, Bk. E. I.	\$979,400
Positive identity control on non-tower	Cleveland ARJCC Detroit ARJCC Oakland ARJCC	
Construction or alterations of existing communications	2 sites	\$74,600



Our best students never graduate.

An American Airlines mechanic is a perennial student. His schooling starts long before he comes to American. Chances are he has already earned his Airframe and Powerplant License (which means he has completed more than 1600 hours' training).

Once American Airlines accepts him, back to school he goes, for more classroom and on-the-job training.

And this is just the beginning! Once on the job as a mechanic, he remains a student. Several weeks of each year he goes back to school to keep current his enormous knowledge of aircraft maintenance.

He will never stop learning. We would have it no other way. Moreover, we believe, would the hundreds of thousands of experienced travelers who regularly fly American Airlines.

AMERICAN AMERICA'S LEADING AIRLINE

Study Sought on Airline-Creditor Ties

By Robert H. Cook

Washington—Civil Aeronautics Board staff members are now again in the question of whether major lenders to airlines exercise indirect control and thus whether CAA approval of loans should be required.

Nearly three years ago CAA told Congress that this problem was an urgent matter requiring additional personnel and money for a detailed study of the airline-creditor relationship. The Board noted that the absence of cost control could "due to the absence of adequate check relationships, run into an airline responsibility" and several staff members might become a "bottleneck" before the Board is fully aware of the situation unless the studies were completed.

Regardless of this strong plea made at a time when the airline industry was deeply engaged in financing programs on which its work and the job yet has not been mentioned once, no other budget request to Congress.

In light of the industry's current debt load of more than \$1 billion, 65% of which has been loaned by insurance companies to local industry and CAA staff members are convinced the Board may not have to act on the need to all control to ensure its own question of three years ago of whether the airline industry now has been forced into financial straits "under the thumb" of the creditor.

A number of Board staff members have long held the view that the existence of subordinated credits to an owner could result in control and thus CAA approval of such loans is required. Airline attorneys have consistently disputed this stand and have said "open checks on the validity" of a company that a creditor "ought" control to refuse but this could be true under the Board staff theory, whether the loan is a \$10 or \$10 million. Some time ago a top airline official stated that an owner could exercise control at all top level management decisions but at the same time, in the case of default, lenders could run their weight in company policy decisions.

New York financial sources, bankers and insurance men, consider the CAA viewpoint specious. As one commented: "There isn't more in the table of a loan, as transportation companies for an asset, get financing."

Those of the industry, in other words, do possible construction on future financing, payment of dividends, and ways to be taken in event of default, of which might be considered as in direct control by some of the lender.

Financial officials made this statement: "The best thing we all can do is to get into running a business as a job, or in other kind of business. We're not interested in financing a company in the first place, which has such long maturity as we'd like to stop it."

Now financial sources consider the airlines likely to have obtained as much insurance financing as they did. It is especially feasible because of the low interest, that loans, run in relative short run, but lenders are able to arrange insurance loans representative to begin in many cases when bank loans are not available, providing for larger long-term loans to finance the need for funds.

Furthermore, long-term insurance company money, which is heavily invested in home mortgage programs or legally restricted in use and investment, is highly selective in lending. CAA has approved as financing programs to lenders on the ground that lenders feel they are much more sophisticated in the money market and in response to the Board. One possible consequence of such a step could be to reduce the industry's subordinated source of funds for the industry.

Board sources term this entire issue of creditor control a "long and tough question" which has never been resolved in CAA, although it has been recognized as a serious question. If the Board does not investigate the problem, they feel it might be explored in Congress since more than 50% of the total loans to the airline industry are held by such firms, major insurance companies.

James L. Spill, President and Vice-President.

Should an investigation be launched it would involve a complex series of legal and financial details in such areas as interest rates, payment of penalties, insurance, marking, capital, equity, maturity, inflation, taxes, or other stipulations which might lead to even pressure on airline agencies.

Since the volume of individual airline loans from major insurance companies is high, although always controlled, it is hoped to secure loan agreements require a close degree of coordination between the lender and the borrower in such an important area which could affect the airline's ability to meet debt and interest payments.

Indicative of the scope of the industry's financing arrangements, that add in the first half the industry's total debt, which is on a long-term basis, debt climbed from \$60 million in 1954 to \$126 million in 1960. In this same period the total stockholders equity increased from \$84 million to \$246 million. The industry's debt to equity ratio, which CAA will study, has risen from 1.1 to 1.1. This has generally advanced beyond a 2:1 ratio.

Under Section 408 of the Federal Aviation Act, the Board has acted to ensure that the industry's control of an asset which might arise from agreements concerning refinancing, the transfer of company, officers' stock, changes or equipment leasing.

However, it has not been able to direct

Airline Loan Agreements at End of 1961

(Millions of dollars)

	Equity	Preferred	Subordinated	Other	Reeds	Total
American	14.8	75	140	—	—	229.8
Eastern	80	20	—	—	20	120
United	—	—	10.4	10	—	20.4
Northwest	112.5	—	11.2	10.4	138	262.2
Delta	13	—	10	10.4	—	33.4
Continental	—	—	—	10.4	26.4	36.8
Northwest	—	—	—	10.4	26.4	36.8
Southwest	—	—	—	10.4	26.4	36.8
Trans World	12.5	5	—	—	—	17.5
Western	24.9	10.2	34.9	1.9	—	71.9
Totals	342.2	260.2	300.2	108.2	472.2	1,483.2

Chart figures compiled from records of the Securities and Exchange Commission. Airline companies have loan agreements signed since 1955 and do not report the amounts of the total loans reported on their balance sheets.

Northwest also has loan agreements totaling \$123 million with Lockheed Aircraft Corp. and \$2 million with the Boeing Co.

Each of Southwest Airlines is accounted for by loans of \$11.2 million from Western Airlines, \$11.2 million from Delta Corp., \$11.2 million from Republic Steel Corp. and \$3 million from Delta. Rep. Western and Delta have no equipment lease with Trans World Corp. as Western.



The J52 stretches Skyhawk's reach

There's a far-engaging new Douglas Skyhawk ready to serve U. S. Navy and Marine Corps squadrons.

Designated the A4D-5, it features an advanced Pratt & Whitney Aircraft J52 turbojet engine that boasts performance and improves range more than 25 per cent. The J52 helps the new Skyhawk strike harder at deep targets, or stay on station longer in close air support missions.

Operating from carriers and forward airstrips, the nimble A4D-5 can seek out and destroy targets over any terrain, with a

wide variety of weapons including nuclear armament. Though primarily an attack aircraft, it has the versatility and endurance to perform equally well in surveillance or reconnaissance missions.

Pratt & Whitney Aircraft's compact J52 delivers 8,500 pounds thrust in the A4D-5. Pound-for-pound the highest performance twin-spool turbojet in production, this advanced engine also powers the Grumman A2F Intruder and the North American Aviation GAM-77 Hound Dog air-to-surface missile.

Pratt & Whitney Aircraft

U A
DIVISION OF UNITED AIRCRAFT CORP.



Argentine Airline Receives First of Nine Avro 748s

First of nine Avro 748 turboprop transports has been turned over to Aerolíneas Argentinas. Planned by a military version, longer wing, all-weather landing, has been submitted to the British Air Ministry in Royal Air Force construction.

prop with possible control of an airline by the major creditor, even though there have been cases in which Board leasing companies have held such control in principle and should be reviewed and in the Board.

Pratt purpose of an CAB investigation would not necessarily be to determine whether or not an airline was actually being controlled by a creditor, but whether the creditor was in a position to exert control in the interest of protecting its investment.

If the Board held that such a situation existed, CAB would not be required to approve that all further financial agreements be approved by the Board before being implemented. One basis for such a finding might be that the airline's operations were engaged in a plan of acquisition in violation of the established dimensions for loans to an airline.

Also in cases where the lender retains loans in two or more currencies, Section 405 provisions might be applied.

ParAm-National Case

As an example of how the Board has acted against indirect control in the past, CAB approved the lease of Boeing 707 equipment between National and Pan American World Airways but rejected a stock exchange proposal between the carrier on grounds that it would result in indirect control of National by the latter airline.

Interlocking relationships have also been closely examined by the Board which forced the investment firm of Lehman Brothers to give up directorships positions in several airlines in 1952 because of a possible conflict of interest in the emergency.

In 1955 and 1957 the Board faced the prospect of granting indirect control to a company's decision that it was possible for a creditor to control the affairs

of an airline through a debt relationship.

The first case involved a \$182,000 loan to Radió Airlines for the purchase of five aircraft. The lender took a charge on the equipment, which the carrier noted was the carrier's only asset. While CAB attorneys held that this arrangement was not an example of a credit situation which might "endanger the aviation industry," the carrier noted that he was unable to decide on the control issue and called for a full CAB hearing on the matter. No hearings were held at though three separate dates were set and the case dropped when the carrier repaid the entire loan.

Second Case

The second case involved the purchase of four aircraft by a supplemental airline, Mirror Air Transport, from the firm of Metropolitan Air Terminal. Through various financial arrangements, the carrier received \$500,000 from Metropolitan which took back, less on the fourth Mirror loan for the CAB noted that Mirror's liabilities exceeded its assets and the carrier's debt that control by indirect control, not through any form of stock exchange, granted the lender, but through debt since Metropolitan was in a position to repossess the aircraft and sell them for a higher price.

The power to control arose from the end-of-the-line situation, and does not depend upon whether it is exercised," he said. "The Interstate Commerce Commission and the Federal Communications Commission have both recognized the power a creditor can exert over a corporation."

The necessity for a full CAB decision on this case was noted when Metropolitan cancelled its agreement with the airline and represented the aircraft

British Airlines Protest Heathrow Restrictions

London-Airline Operators Committee has pointed out a proposed restriction of Heathrow Ferry Terminal to restrict night flights by jet transports from London (Heathrow) Airport the main transatlantic terminal this morning.

Thomsonair told the airlines he is prepared to allow 1,500 takeoffs at night from Heathrow, but that the restriction should be made from the morning Gate and Standard airports.

Airlines had previously told the minister that between Apr. 1 and Oct. 31, about 2,000 night takeoffs would be required between the hours of 11 p.m. and 7 a.m. at London Heathrow during the tourist season peak.

The airlines have pointed out that it is not possible to have them divert north, since Gatwick and Stansted British European Airlines which would be slightly affected since it has about 750 night jet flights planned for London Heathrow in summer, claims it is not seasonally undesirable to use Gatwick at all times, and impossible this evening summer.

Most season is lack of maintenance facilities at Gatwick, which would force B&A to fly empty planes between the two airports and also pay two landing fees.

Ministry of Aviation has told the International Air Transport Association that a special exercise of night jet flights this summer at Gatwick, would not be in the interest of the general public returning directly to the home airport in the vicinity of London-Heathrow.

Readers have stirred up considerable anti-night aviation during the past year.

Operating on passenger and freight services in Europe and North America and on Trans-Atlantic and Trans-Pacific air routes



ROLLS-ROYCE
TYNE
PROP-JETS

Rolls-Royce Tynes power Vickers Vanguard airliners, Canadair Forty-Four civil freighters and CC-106 Yukon military transports and the Breguet Atlantic maritime reconnaissance aircraft. They have also been ordered for two other military aircraft, the Short Belfast and the Franco-German Transall C-160 transports, and have been specified for the Westland Rondeyde.



ROLLS-ROYCE OF CANADA LIMITED, BOX 1460, ST. LAURENT, MONTREAL 9, P. Q.

ROLLS-ROYCE LIMITED, DERBY, ENGLAND

AERO ENGINES • ROTARY CASE • DIESEL AND GASOLINE ENGINES • JACKET MOTORS • NUCLEAR PROPULSION

SHORTLINES

► **Air France** has secured its 25th Concorde for transport-like 1980s scheduled by Sud Aviation. The airline is to receive 17 more by 1982.

► **AirLada** will replace piston-powered Conquestors with Conquest 400 aircraft based from both Chersky Aeroflot Corp. on its Singapore and Dhaka routes Apr. 1.

► **American Airlines** will add a new afternoon round-trip air flight to each of its schedules between New York-Chicago and New York-Detroit beginning Feb. 4. The new flights will be daily except on Saturdays; the eastbound Chicago-New York flight will be omitted. The New York-Detroit air flight replaces an Eastern flight between the cities.

► **Delta Air Lines** reports net income of \$4.9 million, including \$509,000 on sale of aircraft, during 1981. Earnings in 1980 totaled \$5.1 million, including \$14,000 on equipment sale.

► **Pacific Northern Airlines** is offering round-trip Conquestors from Southeast Alaska ports and the Pacific Northwest. Flights will be in effect until Apr. 16.

► **Pan American World Airways** expects to carry more than 20,000 passengers between New York, Boston and Los Angeles during the spring season and better holiday season from Mar. 15 to May 2. The airline says bookings by college students are 25% higher than last year and it will schedule as many as 18 jets weekly with extra services to handle the traffic.

► **Tokyo-Narita** airport jet service has been increased to five flights weekly by Pan American World Airways. Jets leave Los Angeles and San Francisco for Tokyo Narita, three days and Saturdays.

► **Trans-Team Airways** has asked CAB to allow the recently approved 3% fare increases (AW Jan. 1, p. 27) to be rounded off to the nearest lower dollar. An \$18.44 fare—including the 3% increase—would become \$18.

► **Trans World Airlines** reports it will schedule 42 jet flights weekly across the Atlantic beginning May 1, increasing to 46 jet flights weekly on June 1. This will provide six more flights than during the 1961 summer season. New schedules include nonstop Chicago-London service and three-times-a-week service between the West Coast and Tel Aviv and Athens.

AIRLINE OBSERVER

► Watch for Air Force to lodge strong objections against the Tolland Aviation Service bill when it comes up for congressional consideration this spring. A potential Air Force objection from the bill, in written, would give Federal Aviation Agency too much authority over contractors at military installations. Air Traffic Control Area also has developed a lot of objections, but most are of a political nature.

► **Airline traffic** generated by Cape Canaveral, Fla., spaceport has been falling during periods of space launchings, in looking rules and service attention generally offered to other nearby areas. Considering inadequate airport accommodations in the area, flight schedules have been subjected to and are improving. Eastern is adding two daily Douglas DC-8 flights to its schedule at Orlando beginning Feb. 1. However, insufficient rules, regulations and information facilities are existing on increasing volume of complaints from technicians, engineers and researchers who constantly reply to the area.

► **Defense Department** now believes that Civil Reserve Air Fleet's contribution from during the initial phase of a conventional war could be quite small. That would mean considerable large-scale military costs, such as guns and vehicles, which most CRAFT aircraft could not carry. In the subsequent troop buildup, however, CRAFT is counted on to play a major role.

► **Project SCAN**, a system for collection and analysis of non-occupant reports developed by Flight Safety Foundation under FAA contract, is being transferred to airline data furnished by air traffic controllers. A standard form has been developed and distributed to controllers, enabling them to forward information on potential inflight hazards to FAA on an immediate basis. During the first six months of the program, such reports come primarily from pilots.

► **Douglas C-124 Globemaster** transports operated by Air Force Reserve squadrons recalled to active duty last fall will be returned by the service for its indefinite period after the services are returned to civilian flight. Value of the C-124 has an ability to carry up to 100 troops and cargo. Most former C-124 reserve squadrons will be re-equipped with Fairchild C-119s.

► **Aeroflot Chel Y. Luginov** has said that the possibility of using vessels for aerial communications by 1990 or earlier are being studied. He said Aeroflot-Soviet Russia's managers are currently now carrying 100-800 passengers daily and that expansion of the civil air fleet under the Alaska and Dhaka is being stressed.

► **International Telephone & Telegraph Corp.** action for separating air traffic in terminal areas, which was developed under an FAA contract awarded about a year ago, was submitted to the Agency last month. Service specifically is based on a standard indicated airport of 150 ft. per month approximately as airport, altitude separation and priority-based communication calculated by a computer. Service design team set up within FAA to implement Project Beacon report recommendations is studying the proposal.

► **Philippine Air Lines** has been granted a temporary foreign air carrier permit to operate scheduled flights between the Philippines and San Francisco via Honolulu. Philippines demonstrated its bilateral air transport agreement with the U.S. in 1968 so that the permit is granted on the basis of "reciprocity and international concern." CAB has issued a Philippines' report for a Tokyo stop on the transpacific route, but the airline has indicated it will stop there anyway to accommodate local Manila-Tokyo traffic. CAB holds that authority to make a stop must be obtained even though a Fifth Freedom traffic is involved. It also warned that the permit will be terminated if U.S. carrier serving Manila are curtailed.

► **Sen. Warren Magnuson (D. Wash.)** has warned hotel service officers that nobody has become an "agly" word and that it is becoming more difficult each year to win congressional approval of subsidy payments. He said he hoped that nobody payments can be eliminated by 1984-86.



Find integral rational numbers, a, b , (other than 2 and 4) such that $a^2 = b^2$

—Contested

If you're a reasonable amount of experience in the selection and application of systems, sensors, computers, communications, and other electronic components, had a new challenge at our Guidance and Control Systems Division. Things are happening. New ways are being sought to determine component reliability. See Mr. Don Kline for the details.

ANSWER TO LAST WEEK'S PROBLEM: Denoting width and length as a and b we obtain the equation $a = 2b + 4 \cdot b = 2$, yielding 2 integral solutions: 3×10 or 4×6 .

An Equal Opportunity Employer

ITT SYSTEMS, INC.
Guidance and Control Systems Division
Woodland Hills, California

Bowling alley to Marseilles by air?



ship anything swift...safe...sure AIR FRANCE CARGO

Tough cargo problems like the one above are right down Air France Cargo Specialist's alley. (We actually did ship an entire bowling alley to Marseilles!) And we give any size, any shape, any weight product the same kid-glove treatment. That's why you can be sure your cargo will arrive in tip-top shape from the time it leaves the U.S.A.,...all the way to its final destination. And remember, Air France Cargo rates are now up to 65% lower. Same low insurance rates, too. Fly it safe anywhere in the world. Call your Cargo Agent or call Air France. WORLD WIDE CARGO SERVICE / WORLD LARGEST AIRLINE

C-135 Conversion

Washington—The Fair is a rougher whether it is one of the 41 Boeing C-135 transport aircraft ordered by the Military for Transport because they are converted to KC-135 aerial tankers because of the aircraft's shortcomings as a fighter carrier (see p. 66).

Although the Lockheed C-141 tank carrier program will be available in squadron strength until June, 1965, one military Air Force believes that MAT's should be in interim modernization program for the Lockheed C-135. Then, according to that the C-135's ability, tanked length flight time and (space cargo weight offer more value per dollar than the C-135's speed and range.

The last 30 C-135 scheduled for delivery to MAT's will come with tanking capacity. The second stage and third performance made possible by this program probably would make later C-135s more attractive to Strategic Air Command if the conversion plan fits better with Defense Department

Boyd Meets Local Service Chiefs, Sees Little Hope for Subsidy End

Washington—Meeting between 12 local service airline executives and Civil Aeronautics Board Chairman E. S. Boyd last week produced little hope for ending subsidies in the foreseeable future.

Boyd said to do so, with federal subsidy now would mean doing more with local service airlines, and many communities acted by those airlines as a means to get and more to rely on them.

Boyd said the airline officials did not make the suggestion of ending subsidies in a CAB letter Nov. 16. In that letter, the Board and the estimated maximum subsidy it could allow to local service carriers was \$74 million for 1965, \$73.5 million for 1966, \$71.5 million for 1967 and \$67 million for 1968.

Boyd said he presented the industry could live within these constraints.

A major problem brought out at the meeting was the lack of a suitable aircraft for local service use. Boyd said the airlines agreed there is not a true short-haul transport with low operating costs available to use on the domestic routes. The carriers feel that manufacturers are reluctant to design an aircraft for such a limited market.

Local Service Needs

Even if the aircraft industry were willing to design a short-haul aircraft for local service needs, there is no certainty these airlines could agree on what type was needed. Local service aircraft needs are widely varied, the industry, Boyd said. Some operators feel short haul passenger equipment will be the answer while others feel they can use larger, four-engine equipment presently.

CAB Vice Chairman Robert V. Murphy, who also attended the meeting, pointed the efforts of the industry to

meet local better through promotional ideas. While these firms generally have been successful in increasing traffic, it would require more airlines began to place out DC-4s for reduced earnings.

Other Topics

Other topics raised during the meeting included:

- **Joint sales with service carriers.** Boyd and there was little interest in these because local service airlines are presently interested in developing their own traffic.
- **Joint operation.** This led discussion of the joint route in particular was, but might be considered later.

- **Regional airports.** Boyd said the carriers were enthusiastic over this program and would not shy but only in areas where a regional airport would give communities better service at lower cost. Boyd said the carriers had been looking for regional airport plans while waiting for CAB to make the first step, but now were beginning to consider the use of regional airports among themselves.

- **CAB's "vest-to-vest" policy.** Boyd said that carriers were generally satisfied with the policy, and which it might be possible to improve it, the consensus was not to alter it now.

FAA to Initiate New Violations Procedure

Washington—Pilot and all other holding Federal Aviation Agency licenses will be afforded full trial-type hearings on request of possible punishment for a civil violation of aviation certificate, organization or provision.

The FAA policy change follows a recommendation of the Federal Trial-type report, which said that the agency often subjected violators to aviation fines certificates action. Previously, FAA revoked or suspended licenses after informal proceedings, the agency said which could be applied to Civil Aviation Board.

The new policy does not affect that right of appeal. Under it, however, then hearing officers have been appointed to trial through FAA regions, trying cases in their area. The system is being phased in.

In a related action, FAA Administrator N. F. Halliday decentralized Agency responsibility for processing airline noncompliance and safety violations of the Civil Air Regulations by referring regional commands and Flight Standards Field Division checks with the proper to level positions.

WESTINGHOUSE ULTRASONICS

A reliable production tool . . . cleans almost anything better.

De-ice and decontaminating cleaning, ice removal, removal of particle points on assemblies? Westinghouse ultrasonic cleaning can do it. It's fast, pressureless, dependable, too. It cleans any solid state, from electricals to long life bearings and—last but not least—Westinghouse supplies local maintenance and service. Write: Westinghouse Electrical Engineering, 2215 Ardmore Ave., Baltimore 3, Md. For an info. kit.

Westinghouse



Soviet Airfreighters

Moscow—Soviet Deputy Chief G. S. Scherbinov has laid down the Soviet stance by words: "the development of speed cargo aircraft capable of delivering long-distance loads to the sites of new construction projects" is a result seen of the USSR.

Scherbinov's statement indicates that cargo versions of the line-between-An-10 and An-12 are not adequate for this purpose and that larger Russian subsonics are probably being the design stage.



ASSET PROGRAM'S GLIDE TEST VEHICLE is shown in orbit's sketch in hyper-velocity flight to obtain critical, re-entry regime data required for the development of advanced vehicles. Vehicle has 74deg sweep delta platform, with fixed stabilizing flap at the aft and fixed flap pattern of glider in 18 deg. by base stabilizing flap plane. NOTES: 100A glider's orbit vector is seen protruding from aft end of cone's nosecone body.

ASSET Re-entry Vehicle Test Series Will

By Irving Stone

Los Angeles—First in a series of seven hyper-velocity, lifting re-entry test vehicles is scheduled to be launched in July from Cape Canaveral in Air Force Systems Command's Aeronautical Systems Division's Project ASSET. The program is intended to provide basic data, quickly and economically, for design efforts for advanced space systems now being developed or planned for the near future, and to accelerate the art of piloted re-entry capability.

Data, which will be gathered in three distinct test regimes, is seen by industry observers to be applicable to vehicles with glide re-entry configurations, such as Dyn Soar and an entire family of spacecraft envisioned for global surveillance (AW Feb 27, 1961, p 22 Jan 28, p 39).

McDonnell Aircraft Corp., St. Louis, is designing, fabricating and will test and evaluate the seven vehicles under contract with ASD's Flight Dynamics Laboratory.

Project ASSET, tailored for aerothermodynamic structural systems component tests, involves three phases:

- Seven glide re-entry tests will include two aerothermodynamic vehicles, three structural vehicles, and two aerothermodynamic configurations. All to be launched with Air Force Blue Scout boosters. A special vehicle, will be flown to evaluate the recovery system, to be used in the program, to determine vehicle speed its acceptable entry impact value.
- First launch in July, involving an aerothermodynamic vehicle, will be opposite launch 16 months after end of previous test design, which was completed in March, 1961. Second launch will be in late September or early October, 1962 and will involve a structural vehicle. Third launch will take another aerothermodynamic vehicle and is scheduled for November, 1962. Fourth launch in January, 1963, will boost an aerothermodynamic vehicle. Fifth and sixth launches, in late February or early March and in April, 1963, respectively, will involve two structural vehicles. Final, seventh launch, in late May or early June, 1963, will test another aerothermodynamic vehicle.
- Flight evaluation which will be coordinated concurrently with the test, is scheduled to be completed by September, 1963.

McDonnell's first report on ASSET program to ASD will be submitted before the end of 1961.

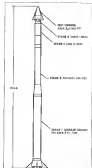
• Detail design of the vehicles will be completed by June, 1962, and fabrication, which has proceeded concurrently with design, will be completed by December, this year.

• General configurations for the three categories of vehicles will be the same: a 70 deg sweep, 14-in. dia, delta platform with stub wings, dictated by 1 sec-maneuver body.

The bottom of the vehicle will be angled up at 16 deg. from a fixed stabilizing flap at the aft end at the configuration. Top line of the vehicle body will be 16 deg. to the horizontal.

• Length of the vehicle, including the NACA 180A inlet meter, will be 71.17 in. Span will be 14.85 in., stub wing leading edge radius 2 in. and nose tip radius 1 in.

• Weight of the aerothermodynamic vehicle will be 550 lb, structural vehicles will be 620 lb. First of the aerothermodynamic vehicles will be 550 lb and the second will be 700 lb. The aerothermodynamic vehicle will not be powered.

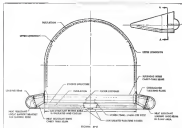


ROCKET-VEHICLE configurations for ASSET program's aerothermodynamic and structural tests show how glide re-entry vehicle will be positioned on top of Air Force's Blue Scout 1.2.3 booster configuration. Fourth stage (NOTES: 100A) vehicle's power vehicle, is not part of booster.

Begin in July

• Radiation cooling will be used in the aerothermodynamic and structural vehicles—one top will be constructed of a clay-ceramic material, leading edges will include structure ceramic and aluminum metal, wing and upper body will use refractory metal and super alloys. The lower body will be shielded with a refractory metal heat shield and an aluminum substructure. The structural vehicle also will incorporate cooling provisions in the lower body. Aerothermodynamic vehicle will be radiation cooled and insulated, will use refractory metal, super alloys and aluminum, but no structure ceramic.

• Booster for the aerothermodynamic and structural vehicles will be an Air Force Blue Scout 1.2.3 configuration—ASSET Sonnet for the first stage, and the XM-13 for the second stage, and Allegro, Bellanca, Labastone, X29 for the third stage. The aerothermodynamic vehicles will use a Blue Scout 1.2 configuration, incorporating the ASSET Sonnet and the Thrust XM-13 stages. Launch weight for the Blue Scout 1.2.3 booster vehicle combination will be 35,000 lb. Weight for the Blue Scout 1.2 booster vehicle combination



SECTION through structural configuration reveals physical layout for this specific vehicle. Other two types of vehicles do not incorporate cooling in the bottom substructure area and no aerothermodynamic vehicles the stub wings are designed for maximum stiffness to minimize aerothermodynamic effects.



ROUGH MAP of Atlantic Missile Range showing important data for hyper-velocity glide re-entry vehicle tests indicate impact points downrange and telemetry coverage.

will be 35,000 lb with aerothermodynamic vehicle No. 1, and 34,600 lb with aerothermodynamic vehicle No. 2.

Three, photographic evaluation data, ASSET program is that second stage of advanced boosters, and lifting re-entry vehicles cannot be shared with other adequate aerothermodynamic test, used aerothermodynamic performance methods and novel approaches for designing advanced structural configuration. It's felt that present techniques, methods and tests, exposed to be, a risk, in the foreseeable future, will not afford adequate means to evaluate re-entry flight configurations to permit evaluation of proposed approaches. For this reason, flight tests in the

critical re-entry regime are seen as the only method solution to the problem of obtaining required evaluation data. McDonnell's approach will be to predict environment characteristics, utilizing various flight knowledge. Each of the three types of test vehicles will include adequate ratings of safety. The aerothermodynamic vehicle, however, will evaluate effects of re-entry on structural characteristics and aerodynamic characteristics will emphasize deformation, vibration and flutter. It will use a range of nondestructive methods, aerothermodynamic effects, which the other two vehicle types will incorporate, testings, range.

The structural vehicle will evaluate structural concepts and materials under

LOOK FIRST TO JVM...

Now Supplying RF Modules and Components for

• ATC Transponders • DME (Distance Measuring Equipment) • Radar Altimeters

JVM has designed, developed and is now producing complete RF assemblies, components and circuits for Air Traffic Control and navigation systems.

Development of ATC and navigational assemblies has long been one of JVM's principal R&D efforts. Recent achievements include a new ATC Transponder assembly that im-

proves reliability, lowest production costs; a DME assembly that features light weight module construction; and temperature/altitude compensated radar altimeter transmitter carriers. Other developments are still being designed down... destined to bring system design engineers new, improved components for the expanding ATC program.

Here's why system design engineers specify JVM...



FOR DME



FOR RADAR ALTIMETERS



FOR ATC TRANSPONDERS

JVM is currently producing a high performance commercial DME for carrier transmitters. The unit comprises a superheterodyne detector, preamplifier and amplifier chain which produces 2-800 watts peak power. The receiver has a 10% bandwidth. The transmitter is a 12% bandwidth. Both bandwidths are centered about 1080 mc. The equipment meets FAA and ARINC specifications.

JVM has also engineered and developed components for the major equipment in TACAN, DME, and VME, and provide ground station systems.

Whether you require a complete RF

JVM has completed research and development on transmitter carriers when temperature compensation is important. These units were designed for military applications and are now in production.

assembly, or individual components to your system design — airborne or ground — you can use valuable R&D time and reduce production costs through JVM engineering and mass buying capabilities. Call or write us

JVM is currently in production on a complete RF assembly for a carrier unit. This unit is designed for military applications and is now in production. The unit is designed for military applications and is now in production.

a certain condition. The aerodynamic forces vehicle will experience, changes in air temperature, fuel flow and pressure distribution, data used to correct measurements.

Desired heating and pressure conditions will be provided by flights at different angles of attack. Increase in altitude at beginning of glide will increase the severity of temperature effects.

Aerothermodynamic vehicles will be designed to a virtual isobar heating for about three minutes of glide.

Maximum temperatures of structural and aerothermodynamic vehicles will be experienced only in the glide phase. Lower orbital glide velocity of the aerothermodynamic vehicles will give lower vehicle temperatures than experienced by structural vehicles.

General tests, preceding and complete, covering the flight program, will be used to evaluate critical components, and vehicle tunnel runs from Mach 0.5 to 20, include wing tests, development and environmental tests for structural components and systems, and analog computer runs for guidance and control hardware, which will include base line. Some components such as pitch servomotors, three-axis rate measuring gyro units, amplifier units, and navigation test systems. These ground test data and analytical predictions will be compared with flight test results.

Level flight trajectories for the three types of vehicles will provide horizontal flight at beginning of glide, and level turn capabilities glide path. Subsequent trajectories will provide flight at side bend angles of attack and, for the third structural vehicle, oscillations in the flight path about the equilibrium flight path as the result of an initial dive angle and level turn control.

Under the initial flight trajectory, both the structural and the aerothermodynamic vehicles will begin glide when about 250 and 100 downrange and at altitudes of about 251,000 ft and 275,000 ft respectively. When speed will be about 18,000 ft. The aerothermodynamic vehicle will end its test approximately 600 sec as downrange, when it is at an altitude of about 21,000 ft, shortly after 7 min from launch.

Under the initial flight trajectory, both the structural and the aerothermodynamic vehicles will begin glide when about 250 and 100 downrange and at altitudes of about 251,000 ft and 275,000 ft respectively. When speed will be about 18,000 ft. The aerothermodynamic vehicle will end its test approximately 600 sec as downrange, when it is at an altitude of about 21,000 ft, shortly after 7 min from launch.

Vehicle Recovery

Recovery for the structural vehicle will be initiated at about 60,000 ft altitude, after about 15 min from launch. The vehicle will impact upon roughly 1,700 sec of downrange, after about 29 min from lift-off. A recovery ship will be standing ready for the pickup.

The aerothermodynamic vehicle will be recovered at about 10,000 ft altitude, after about 150 sec of downrange, when speed will be about 12,000 ft. Recovery will be initiated at about

60,000 ft after about 15 min from launch and the vehicle will impact about 500 sec as downrange about 11 min later.

Recovery sequence will involve deployment of drag chute and at about 25,000 ft the main chute will be deployed, and at about 20,000 ft, the vehicle will be slowed to about 1,000 ft/sec. The vehicle will be slowed to about 1,000 ft/sec. The vehicle will be slowed to about 1,000 ft/sec.

At impact, shock updraft and the carrier will be ejected.

Recovery installation on the three types of vehicles generally is simple. Recovery about 3 ft aft of the vehicle's nose, primary power supply and control systems are installed. Behind this is a shield which supports, on its top, the instrumentation components and a base on its end, on its bottom, the television camera.

Next volume of accommodations preflight and instrumenting under the instrument and some control electronics. All of this, just above the field stabilizing top area, additional control electronics, an inverter and

control tank are located. The rear most portion accommodates the recovery system, recovery control gear unit, on two of the vehicle type, the SOTS 100A rocket motor.

Instrumentation will be designed for the specific mission of the vehicle. Instrumentation will cover approximately 175 data points, providing at least temperature, pressure, acceleration, attitude, vibration, thrust, deflection, position and control parameters.

Re-entry Conditions

Aerothermodynamic vehicle will use a PPM (X-band) telemetry system, which structural and aerothermodynamic vehicles will use FM (VHF) telemetry system. One of the purposes of the test will be to evaluate conditions of tracking and telemetry under glide re-entry conditions.

Structural and aerothermodynamic vehicles will carry a tape recorder for one minute of recording. Blackout and playback prior to flight termination.

Position and speed data will be obtained from tracking of vehicle's C-band beam.

Van Allen Belts Are Not Sharply Defined, Explorer 12 Data Shows

Washington—Explorer 12, energetic particle satellite has returned data which indicates there is no sharply defined data between the inner and outer Van Allen radiation belts, but rather a wide belt area, from 45,000 to 100,000 miles.

The previous belief that there were two doughnut-shaped magnetic belts has given way to a new theory that there are various intensities of trapped particles from 400 mi above the equator out to 26,000-45,000 mi. Both inner and outer belts are distinct boundaries, according to Explorer 12 data, but the outer boundary, "fuzzy" in reference to the effects of the solar wind.

The area of trapped particles is called the magnetosphere, and although its characteristics vary widely, total mass of the particles has been estimated at no more than 1 lb.

Measurements in regions of the magnetosphere have returned three data: High energy proton with energies in the range of electron volts (MeV) range, at 1.5 earth radii; Low energy protons of a few MeV range, at 3 earth radii; and 2 MeV electrons are found at 4 earth radii.

Soft electrons of 16,000 electron volts predominantly from 10 earth radii to the outer limit of magnetic influence, which is almost sharply defined, but varies

from day to day from 5,12 earth radii (At earth radii is approximately 3,940 mi).

Explorer 12 was launched Aug. 15 as a Delta probe from the Atlantic Ocean. The probe (AWA No. 25, 26) is about 100,000 ft (12 days later), but there is some chance that it would begin transmitting again when the angle between the sun and the probe's ray of vision is about 25°. With this angle, the solar cell panels will provide a sufficient output to capture satellite electronics.

Solar Storms

The satellite was exposed to three solar storms in July, August and early September and high energy protons bombarded instruments as a result of them, but damaged quickly. Low energy ions were detected.

From these observations, it has been concluded that lower energy protons are associated with magnetic storm clouds from the sun, but would be associated with solar storms.

Advanced instrumentation in the State University of Iowa trapped electron experiment showed that the intensity of electrons with energy levels above 40 KeV, in the outer zone is 100 particles per cm per second a factor of 1,000 less than previous measurements. Radiation levels are not decreased by the new measurement, however.

Another observation from Explorer



DIVISION OF — **Fidelitron Microwave Inc.**
6300 W. 47th Street, Brookfield, Illinois

A new science-technology supports decision-making on a global scale. How do you control world-wide forces when decisions must be made in minutes or seconds, based on huge amounts of information, which in turn must be literally up-to-the-second? Decisions of this scale are made possible by a new science-technology: systems that provide information processing assistance for military and governmental leaders.

Scientists, Engineers and Computer Programmers at SDC have been on the growing edge of this science-technology since it began with SAGE (the first system of this type) and SACCS (the second system). Today Harman Factors Scientists, Operations Research Scientists, Engineers and Computer Programmers at SDC are deeply involved in a number of new systems. Working in a close interdisciplinary manner, they are contributing to these systems in areas of: system analysis, system synthesis, programming, joint computers, training personnel in the use of the systems, and in system evaluation. They are also carrying on research into future generations of these systems. What does this new science-technology offer you professionally? We invite your inquiry on this score if your ambitions, background and curiosity turn you toward this new field. Address: Dr. H. L. Best at 2432 Colorado Avenue, Santa Monica, California. Openings are in Santa Monica, Washington, D. C., Pasadena, New Jersey, and Lexington, Massachusetts. "An equal opportunity employer."

System Development Corporation



SDC
Systems that help men
make decisions and
exercise control

DECISION-MAKING ON A GLOBAL SCALE

Instruments Evolve for Mariner Probes

By RORY MALLIN

Pasadena, Calif.—Several hundred of light-weight, lightweight instruments designed to gather scientific data about Venus, Mars and the environment of these planets and ultimately contribute to manned planetary and interplanetary space exploration are being made by the instruments program.

The instruments are in various stages of development. Some are in the final stages of development and will be delivered to the Mariner R probe in the near future. Others are in the early stages of development and will be delivered to the Mariner R probe in the near future.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969. The probe will be launched for the first time in the summer of 1969.

The probe will be launched for the first time in the summer of 1969. The probe will be launched for the first time in the summer of 1969.

The probe will be launched for the first time in the summer of 1969. The probe will be launched for the first time in the summer of 1969.

The probe will be launched for the first time in the summer of 1969. The probe will be launched for the first time in the summer of 1969.

The probe will be launched for the first time in the summer of 1969. The probe will be launched for the first time in the summer of 1969.

The probe will be launched for the first time in the summer of 1969. The probe will be launched for the first time in the summer of 1969.

The probe will be launched for the first time in the summer of 1969. The probe will be launched for the first time in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

A group of Mariner R instruments, which will be delivered to the probe in the summer of 1969, are being prepared. Officials here emphasize that the first selection of instruments for the first flight (designated Mariner R) is in the form of the Mariner R probe, which will be made by NASA headquarters, when responsibility also covers the choice of experiments with which JPL works in preparing Venus and Mars instruments.

A large number of experiments that could be with one single shot (radio light weight) instruments are in development to give NASA greater flexibility in selecting experiments, one of which is a large dish (the probe weight) which is a function of launch date.

JPL, which selected, instrument selection to prepare instruments for Mariner R, which is an on-board program.

Instruments prepared for Mariner R include:

• **Infrared radiometer**—The two-channel infrared radiometer, which will view the temperature in the Venusian atmosphere in the mid, equivalent not included for Mariner R. The probe weight 23 lb. has five levels of launch date comparison, one level of temperature detectors and provides color detection. In two channels will view radiation at one to one meter and between 10 and 10.5 microns.

Mariner Program

Planetary spacecraft Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

The infrared radiometer will be built under an extremely tight schedule by Brown Engineering Co., Stanford, Calif. For about \$100,000, according to Marshall Jones, deputy chief, Space Sciences Division of JPL. The probe will be made by JPL, the mission of California and Nevada.

• **Micro-wave radiometer**—The probe will be built under an extremely tight schedule by Brown Engineering Co., Stanford, Calif. For about \$100,000, according to Marshall Jones, deputy chief, Space Sciences Division of JPL. The probe will be made by JPL, the mission of California and Nevada.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

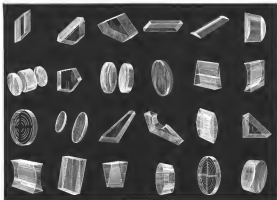
Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.

Mariner R, which was the designation given to spacecraft scheduled for the first mission of the series, is scheduled to be launched in the summer of 1969.



OPTICS FOR ELECTRONICS...

Components and systems for visible, ultraviolet, and infrared radiation. GEC's Astro-Optics Division specializes in design, development, and manufacturing of optical components and systems for the ultraviolet through infrared spectrum.

Here are a few of the optical components you can order from Astro-Optics: prisms, flats, spherical, aspherical and parabolic surfaces, reflectors, information choppers, encoders, precision vacuum coating, and optically polished synthetic crystals.

Also available from Astro-Optics are infrared and optical-electronic systems.

For complete information regarding your precision optical requirements, write today to:

ASTRO OPTICS DIVISION

... precision optics at work



GENERAL ELECTRODYNAMICS CORPORATION

4430 FOREST LANE • GARLAND, TEXAS

There are a number of evenings for employees and suppliers on GEC. For information write today to Page 8.

from the Marconi microwave measurements.

► **Magnetostrictive**—Thin film gate type of magnetostrictive under development for Marconi A and scheduled for Marconi B, will measure the strength of interplanetary and Venusian magnetic fields. With its detector, the magnetostrictive, made by Mansfield Industries, weighs 4 lb. Its sensitivity is set in great part by that of a rubidium gas magnetometer flown in each Ranger shot. The strength and nature of these fields may have an important bearing on the design of future communication systems.

► **Plasma probe**—Plasma probe being developed by JPL will measure the level of plasma in interplanetary space. The probe is similar to one on Ranger, but only one probe, pointing at the sun instead of the sun at different angles as Ranger. It will weigh 4 or 6 lb., have an energy spread up to 8,700 electron volts and will be testing probes

Separate Studies

For Marconi B there are separate plasma studies under way, one at JPL, one at electrostatic deflection center, the other at Massachusetts Institute of Technology on a 100-ton cryo system (under Prof. Brian Rosen and Herbert Kroger). In the latter, the grid is made latent and repels particles about certain energy. The MIT device has wide acceptance angle, the JPL probe has a smaller field of view, greater detection limit. The JPL Marconi B probe will have higher angular resolution than the Marconi B device and will use four parallel pointing of the sun.

► **Coarse dust detector**—is a half pound device, developed by Goddard Space Flight Center, will measure coarse dust colliding with spacecraft.

► **Reduction chamber and Geiger counter**—with gaging chamber (chamber) and then, Geiger counters in a rough package will measure particles-potential and electron-measuring low areas of great importance are concerned. The chamber is a NaI crystal, a JPL California Institute of Technology, is prepared. One tube has a copper plated steel window, the other a boron-free window. The process of electron shield is indicated in a detector in the count. Tubes are in a 10 mci shield for probes. A third tube in the package, but not part of the gaging component has a steel end plate and will count particles in an optional Van Allen type tube. Dr. James Van Allen will supply a calibrated detector.

In all there are over 40 separate components being studied in the Marconi B by JPL Space Sciences Division. JPL's prime interest in the work is to return plasma information while interplanetary information is looked upon as a bonus to supplement data obtained in other NASA probes. Yet

most of the instruments shared Marconi B, with the exception of the instrument will be operating during the transit or well in the interplanetary phase.

An ultraviolet spectrometer, which had been reached by Marconi A before it was cancelled and is one of the most requested instruments for Venus atmosphere will be held for one of the Marconi B shots. This instrument, built by Spac. Technology Laboratories on an S105000 contract, will provide an instrument of the instruments in the upper atmosphere of Venus and Mar. It will perform spectrometric measurements over wavelengths from roughly 1,100 angstroms to 4,300 angstroms and may detect atmospheric composition, ionization and levels of constituents.

The light model for Marconi A

weighed between 20 and 26 lb., and required a high transmission but rate or storage capability, neither of which is available on Marconi B. Hence it is regarded as a second generation Marconi instrument. It has a sensitivity of 10 Rayleighs and resolution of 10 angstroms.

Before possible use in a B shot, the spectrometer will be modified and subjected to extensive static tests, temperature cycling and other tests. There are problems with light rejection that will have to be solved well before space use.

The spectrometer covers constant deflection system and can be blown off through splash separation prior to its use in the neighborhood of a planet. If it fails to operate in case of more

Deep Space Tracking Facility Conversion

Pasadena Jet Propulsion Laboratory will arrive a step closer to its goal of having all its deep space instrumentation facilities (DSIF), which will track planetary and lunar probes, operating on 5 March by June, 1965, with the arrival this month of a production contract for the facilities' new receivers and transmitter circuitry.

A working prototype S-band receiver, made by Holloman Electronics under a JPL development contract (NWS No. 1-375), now has been installed and tested at JPL's Goldstone facility as time for testing of the first Marconi B shot late this summer.

A contractor will be selected from among over a dozen bidders who are making the job of supplying two S-band (2,350 mc.) phase coherent, synchronous tracking systems and two UHF systems centers for JPL. A track working prototype, currently in use at the prototype facility, are being developed by Holloman. Venus Associates is developing an S-band (2,315 mc.) transmitter under a \$150,000 JPL contract.

Companies which have submitted bids for the receiver/transmitter job part of the acquisition and expansion of the facility from UHF to S-band, probably include: Ayles, Defense Instruments, General Dynamics, General Dynamics, Holloman, Hughes, International Telephone & Telegraph, Motorola, Philco, Radio Corp. of America, Sperry Rand and Westinghouse.

Radio frequency equipment being produced and facilities where they will be located are as follows:

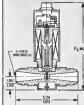
- **Goldstone** has a DSIF 2 will have a three-channel tracking receiver; plus a tracking receiver channel provided with various telemetry detection channel and Doppler detection subsystem. That will be capable of two-way operation with DSIF 3. DSIF 2 will have some equipment of the DSIF 2 plus a UHF center channel with frequency detector and a tracking radio frequency receiver. DSIF 2 will have tracking receiver and carrier.
- **Westinghouse**, under contract DSIF 4 will have three-channel tracking receiver, additional tracking two-channel with auxiliary telemetry detection channel and Doppler detection subsystem. In addition a UHF center with frequency detector equipment needed for single use dependent operation will be included.
- **Lockheed**, South Africa-DSIF 5 will have equipment similar to that at DSD 4, Westinghouse.
- **Irresponsible** system-DSIF 6 will have a three-channel tracking receiver with additional tracking two-channel, each with telemetry telemetry detection and Doppler detection subsystem.

- Each receiver will have the following outputs:
 - **Wideband** received intermediate frequency signals to intermediate frequency equipment.
 - **Doppler** extraction and telemetry channel.
 - **Automatic** gain control voltage output for signal strength indication.
 - **Low level** auxiliary telemetry reference signal at 2,350 mc.
 - **Second and third** band receiver reference signal.
 - **Discontinuous** signal rate signals in two channels.

The UHF system will be designed to detect radio frequency signals appearing at various frequencies of 7.143 mc.

All equipment is to be delivered to JPL within one year of the date of contract award.

Cryogenic solenoid valve features direct action and venturi flow!



A detaching, high-flow, bearing and sealed valve design, featuring the cryogenic, venturi flow action. VALCOR features an internal bearing design — all external parts are supported by metal pins, free of fluid media contacts, and all metal surfaces, avoiding contamination. The formation of non-metallic scale, built known design for 100% performance. APPLICATION: Compression gases, gases that the floating seal when the valve is designed for full-scale valve flow is equivalent to 300 diameter size pipe orifice.

Larger sizes also available featuring Venturi flow Multiple Valve Proportions. Applications: Liquid Nitrogen and Gaseous Oxygen delivery to Liquid Hydrogen, Liquid Oxygen, Propane, Air, etc. Maximum Airflow: 100,000 cubic feet per minute. Weight: 4 pounds.

Write today for complete specifications.

VALCOR
ENGINEERING
CORPORATION

PO BOX 1000
3294 George Ave., Emeryville, N. J.



Centaur Vehicle Simulator Checked Out

General Dynamics/Aerospace division is test Centaur mechanisms in new space conditions being checked out at the firm's San Diego facility. Major purpose of the simulator is to duplicate flight conditions, especially zero-gravity periods, through which the hydrogen-powered Centaur launch vehicle will travel. Light at the left center in the multi-exposure photo is an artificial sun which activates ion-structure which are located on the parking buses. During flight, satellites would turn on the left end of the Centaur toward the sun to prevent hydrogen fuel from freezing and allowing it to go. Hydrogen must be maintained at -430° to ensure no liquid flow. Two buses shown above are attached to a 30-in.-dia. air bearing which runs on a thin cushion of gas provided through holes in the supporting columns. The simulator's detacher environment enables the fluid which will be used in space. Centaur will be launched atop a Saturn D Atlas sounding trend by General Dynamics/Aerospace.

mission time can be altered in the following experiments.

Backup experiments for the ultra-quiet spectrometer are under study at JPL and Consolidated Systems Corp. Two types of infrared spectrometers for use in Mars 3 flights are approaching evaluation by JPL and possibly one or both of these will be approved for further development. One is a gas-phase spectrometer, a hand-held model which was completed by Perkin-Elmer Corp. (JAN 1, p. 19).

The other, being developed by Black Associates, Cambridge, Mass., is a Michelson interferometer which can have a broader spectral range (2 to 6 microns) compared with 2 to 4 for the Perkin-Elmer device although it can place a heavy burden on data handling, causing bottlenecks of Mars 3 spectrums.

Any of these devices is to help determine whether there is an atmosphere from life on Mars by detecting infrared emissions (at roughly 14 microns) from complex molecules, representing a viable form.

JPL currently is looking at the possibility of operating from Mars also includes on all instruments being capsules that could be land-landed on Mars or Venus. While such a step would be a real-life departure from the Mars program is not planned, it would find a clear scientific parallel in the projected hand-landed lunar capsules of Ranger 5 through 7. The planetary capsules might use the atmosphere of the planets in

place of the atmosphere needed for the three Ranger spacecraft. Use of drag deceleration is a distinct possibility, although heavy load protection would be a necessary for the capsules.

The Space Sciences Division does not build flight instruments, but rather, but as a sub-contractor this task to industry.

Data Collection

Scientific data collected by Mars 3 instruments will be collected by a data conditioning system which puts it in proper format for transmission to ground facilities. The system was built by Data Control Corp., Los Angeles.

The conditioning system weighs about 5 lb. drives less than one watt of power and will accept both analog and digital inputs. It can handle about a dozen analog inputs, such as plasma probe, magnetometer, ultraviolet star analyzer, infrared bearing temperature and infrared channel inputs, converting and encoding them into digital format. Similarly, it accepts such digital inputs as ion chamber counts, power level counts, power supply sampling and particle loss inputs.

Data is put into a base frame rate of 71.4 bits through transmission of 16 words.

Timing requirements on and off will be done by a central computer and supervisor (ground computer).

Solar panel arrays, composed of 13,150 cells in an unusual flat cell layout, are being fabricated by Spectrolab

North Hollywood, Calif., for Mars 3. Storage batteries will handle peak loads.

The cells are laid out in a circular layout pattern with no physical contact among them. This may offer advantages over normal solar cell single arrangements in its ability to withstand shock. The cells will be connected in series and parallel, providing a form of multi-type redundancy.

Venus Examination

For the scientific examination of Venus, experiments of potential importance to NASA/JPL are the ultraviolet measurements, ultraviolet spectrometer, possibly infrared spectrometer and determination of the atmosphere, intensity of magnetic fields and radio waves.

For Mars, obtaining television pictures of the planet is among the top priority study. Infrared spectrometric measurements, ultraviolet spectrometric measurements and fields and belt measurements are of top priority.

Measurements of cosmic dust, charged particles and magnetic fields will combine center of interest of Mars interplanetary measurements.

Television viewing of Mars will require storage during flight and return of data after the Mars probe spacecraft has passed the planet.

Storage requirements will require a heavy burden on high-density tape systems.

Experiment Selection

Actual selection of experiments for Ranger 3 depends on a number of factors, including launch date. An option period is being worked out by JPL and NASA to develop the Mars probe design in Venus and earth approach their closest approach, when the Mars probe is launched for the launch vehicle requires the least velocity in which the Mars probe (JAN 1, p. 17). Since weight of payload can be traded for vehicle velocity, final choice of instruments may not be on the launch date.

Bristol Siddeley Forms New Propulsion Group

London—Bristol Siddeley, England, Ltd. has formed an Advanced Propulsion Research Group to study new techniques in aircraft and space propulsion.

Group will, in addition to capabilities of Bristol Siddeley, gas turbines and turbo-propellers, cover the physics of metals and alloy systems for selection in space propulsion. Group leader is Dr. R. B. Jackson, former head of aircraft development and current chief engineer of the Aero Division. The project activities of 70 men, most of whom will come from the major research department.

NOW! Adjustable Diameter and Open THOMSON BALL BUSHINGS



Adjustable Diameter BALL BUSHING for Zero Clearance

The BALL Bearing for all your

LINEAR MOTIONS



Precision Series "A" and Low Cost Series "T" BALL BUSHING

Open BALL BUSHING for Zero Clearance on Tapped Shafts

Sliding linear motions are easily always available. Thousands of progressive engineers will designers have solved this problem by application of BALL BEARING. In your design, remembering shaft, pin, nut, or screw, or for support of any mechanism that is moved or shifted in a straight line.

See your year product! The date your design and performance with Thomson BALL BUSHING!

NO W FRICTION - ZERO SHAKE OR PLAT
ELIMINATE BINDING AND CHATTER
SOLVE SLIDING LUBRICATION PROBLEMS
BEING LIFE - LASTING ALIGNMENT

The various types cover a shaft diameter range of 1/8" to 4", shaft hole diameter in Stainless Steel. Write for literature and name of your representative in your city.



THOMSON INDUSTRIES, Inc.
Dept. F, MANHASSET, NEW YORK

Also Manufacturers of MYLINED Bearings... Sleeve Bearings of DuPont Nylon, and 68 CASE... Hardened and Ground Steel Shafting

NATO Makes Progress in Air Defense

By James D. Hendricks

New York—Development of an effective air defense system for North Atlantic Treaty Organization's European members and Turkey—a complex task, against public opinion ranging from glee to through light laughs—appears to be making important progress, according to K. C. Black, president of Securite Airborne Corp.

Black, who heads a group of industry security specialists at Cassino, Mass., formerly was chief scientist with United States European Command and worked closely with planning at NATO on defense, until returning to this country a few months ago.

He discussed the NATO situation at a presentation to the annual annual meeting here of the Institute of the Aerospace Sciences (AW Jan 29, p. 38).

European air defense is a problem suggested by factors of geography, politics, economy and complex intercom-

as well as the inevitable factor of technology, Black indicated.

Those who are concerned with this problem in Europe often look to United States solutions, or appropriate NATO ideas, in appropriate also for Allied Continental Europe. (The agency primarily responsible for NATO air defense.) Actually, the European problem is in many ways more difficult than that of air defense of continental North America "he said.

Critical Points

Black discussed critical points pertaining to NATO European air defense.

• **Unique threat posed in "an enormous number of air-breathing vehicles which the Soviet Union and its European satellite nations could launch against NATO Europe and Turkey. Long endurance aircraft would act as weapons between the border frontiers there. For the east part, a constant land mass and to a great degree, a constant border. In many cases, a single enemy**

aircraft could perform a bombing mission, return to its own territory, refuel and strike again the same day.

He also noted that a bomber in the 6000 ft. speed stage could penetrate NATO borders and within 30 min. reach many of the prime targets within NATO European countries. "In 30 min. the plane would have reached virtually all of these targets and could be starting home again," he said. "Currently speaking, there may be some results as time to follow defense procedures which might be suitable for use in North America.

- **Intensive use of electronic countermeasures systems to nullify defense systems can be expected, Black, said. He cited use of jamming equipment against Radio Free Europe and Voice of America broadcasts as proof that the Communists have extensive ECM at their disposal and added that "hundreds of anti-ECM systems are needed to provide adequate NATO air defense."**
- **Political problems stemming from**



MI-17 Crashed 600 Yards From Missile Base

Wreckage of the Soviet-built Helwan air force MIG-17 which crashed about 600 yards from an operational Jupiter IRBM base near Agnoli, Italy (AW Jan 26, p. 12) is shown above. Aircraft carried both self and nuclear missiles and, according to Italian authorities, the fire was removed from the largely intact fuselage. The Italian government is completing an investigation of the accident, which occurred on the night and pilot, Lieutenant Colonel Soder, who sustained a fractured collar bone and possible skull fracture.



Crusader First Aircraft to Land on USS Enterprise

First aircraft to land aboard the nuclear-powered aircraft carrier USS Enterprise (CVN-65) was a Chance-Vought F4U-1 Crusader piloted by Col. George Tyler, commander of Carrier Group 1, who was also the first pilot to be catapulted from the carrier's deck. The F4U, four Douglas A4D-2N Skyhawk attack aircraft and three Douglas AD-1N Skywarriors made a total of 171 landings during a twelve-day cruise off Jacksonville, Fla. Some aircraft will remain aboard carrier to participate in planned Mexican orbital operations.

national sovereignty, traditions, international policies and other factors could diminish or negate the value of weapon systems or procedures which might play vital roles in maintaining control to defense.

Black pointed out that a broad set of practical rules for equipment of land air assets, particularly NATO borders was not available until the summer of 1960 and added that even these standards "are several years long and hard to understand" (AW Jan 29, p. 10).

Before the rules were developed, Black said, NATO membership probably "not hoped that if a border or crisis point occurred, some local commander or senior officer would shoot him down before anyone higher up had to order it done."

The problem here was basically that member states were concerned that if NATO forces based in their individual countries developed an aircraft, the act might be considered an aggression by the individual nation as well as by the treaty organization. Thus, France, for example, would want that a French aircraft could be involved in a decision to attack the Soviet coast France.

• **Lack of coordination in air defense planning could have resulted in drastic emergency in the past, Black implied.**

He cited a meeting a few years ago, shortly after the decision to deploy U.S.-developed Jupiter intermediate range ballistic missiles in Italy. NATO officials responsible for planning air defense rules and procedures for Italy attended the session.

A NATO officer in charge of hearing defenses, was asked what procedures had been used to protect the missile sites, Black said.

"The reply... that was 'What would you do?' Black recalled. "It was obvious to me that they had told him about the Jupiter plan. The next day, a contract had to cover it up."

Black sketched this point with a hyperbolic variation in which it was decided that a chain of 20 air defense units was needed to provide warning for NATO European members.

If one considers that a very simple radar unit might cost in the neighborhood of \$15 million, not excessive by modern U.S. standards, the cost of the entire chain would consume more than three-quarters of the entire military budget of the four least prosperous NATO nations," he said.

Black indicated that the radar site selected for use in NATO air defense are made in performance to the Barikade ARSR-7, which uses an omniscient tube for high power output. The ARSR-7 is designed to handle a target intelligence where they get better to both. The ARSR-2 or its earlier version ARSR-1 and ARSR-3, already installed in several Soviet U.S. and Canadian airports.

He said a 40-kilowatt transmitter system, designated "Ac High," which is designed to meet long-range requirements for linking NATO air defense centers and units, will be installed in this, near future.

No solution has been made at a general environment is shown for command and control of NATO air defense, Black, said, but at least two systems offer strong possibilities for application to the problem.

One is the USFV 413L Air Weapons Control System, the other is both around Strike 2, a French data processing system being installed in parts of France. Any ground environment system chosen for NATO Europe must be capable of integrating weapon information, defense and communications systems of wide variety, manufactured by the U.S. and other NATO nations, Black said.

Supersonic Airliner Noise Factor Cited

By David A. Andrus

New York—Noise is emerging as the governing factor in design choice of supersonic transport aircraft, and the defense, operational considerations and direct operating cost estimates of the new noise factor.

Technical sessions on the problems of supersonic aircraft design at the 1978 annual meeting of the Institute of the Aeronautical Sciences (IAS) Jan. 7-9, 1978, emphasized this problem in numerous sessions. For the first time in the history of aviation a transport airplane was designed by consideration of the noise, rather than of the traffic pattern of airports.

R. J. Patton, of General Dynamics/Pratt, said that the IAS that same hour may force the design team speed above Mach 3. The reason is that ground operations—the engine—may be more heavily induced at speed because for a constant altitude, and also as cruise altitude increases.

Patton's report stressed that ground factors are influenced by the noise factor, because reducing the intensity of the noise requires lower wing loadings and higher direct weight ratios. Both design parameters are geared at the point of increased wing cost and increased direct operating cost.

Patton, he said, said that the supersonic transport is pushing the state of the art, just as the new aerospace, more design transport did in the 1950s. This demands further research in aerodynamic structural and propulsion problems, as well as in the noise factor.

Benefits of direct operating costs to noise and total aircraft weight are emphasized in a report prepared by General Electric Co. and M. A. Sains, W. J. Lee, D. E. Smith and R. J. Schmitt of the Flight Propulsion Division.

Three parameter studies of a 150-passenger, long-range, supersonic transport showed that calculated operating costs were dependent on three of cost: cruise altitude, propeller speed, and the low speed cruise direct operating cost (DOC) of the supersonic transport was 50% of the conventional aircraft. In the low speed, which is assumed that constant followed the recommended operational procedure to minimize noise, the relative DOC was 11%.

It should be pointed out that such operating costs are very sensitive functions of direct operating costs. At other meetings, dealing with the supersonic

transport, speakers have said that a few additional engine thrusts or direct operating cost may make or break their operation.

The authors said that DOC was dependent to a large extent on the type of engine and its development. But analysis and engine based on the 1975 design parameters. If there is a significant, proved, constant, then improved performance and lowered DOC would result.

But the report also, effects on DOC of two-sided combination on the direct operating cost.

- Low-speed climb path increased DOC from 17 to 14% above the other as noted during a study climb.
- Subsonic cruise loss of 300 mph in the design cruise—Mach 3 cruise, 3,500-knot—noise—increased DOC by 10%.
- Hot day operations of supersonic transport will increase DOC from 10% to 18%.
- Future solutions in accessible perceived noise levels on the ground—from the currently acceptable 112 PNdB (perceived noise decibels) to 104 PNdB—could increase DOC from three to 11%, depending on engine type and climb path.

Unconventional Engines

Combustion principles of non-rocket engines and their transport acceleration and noise of a supersonic transport was prepared by Carl H. Bolder and Elizabeth Coudas of The Maxwell Corp.

One of the most important system was integrated in this proposal for subsonic flight, then offered the option of turbofan engine selection.

In considering turbine acceleration and separate cruise parameters, the authors concluded that engine weight is more critical than specific fuel consumption in a supersonic transport. This, again, said that conclusion is proper, a clean, rapid engine, with no fuel rocket engine, provided an integral part of its burner-burner design.

The report has a variable-speed, intake with internal contraction, the inlet can be closed completely to eliminate cooling drag. And for the engine is a standard turbofan engine, the engine is based on noise.

Butter packed features are the most striking advantage claimed by the Maxwell Corp. for such a system with the design of supersonic transport, depending on the needs of the transport acceleration problem. If subsonic cruise conditions

require higher cruise altitudes or steeper climb angles, the authors say the advantages grow even greater.

Noise level generated by the propeller was noted as being less than other propellers on the authors. Probationary calculations for a similar aircraft showed such engine-based noise levels, but itself noise levels are significantly below those of other engines.

Handling Qualities

Approach and landing characteristics of a delta wing aircraft configuration for a supersonic transport are inferior to those of current transport aircraft, said four authors from National Aeronautics and Space Administration's Ames Research Center.

Marion White, Melvin Sadali, Bob and Ben, and George Cooper reported studies of piloted simulator studies of the supersonic transport to the IAS, with several emphasis on the problem of raising control problems.

Among the results of their work, they found:

- For cruise flight, changing demands and possibly some state derivatives will have to be integrated. This, in effect, calls for stability augmentation system.
- Derivatives, for those who have for gotten their calculus, express the rate of change of one parameter with respect to another. A dropping demand calls for the rate of change of acceleration during about one sec. out of an aircraft. A state derivative defines the rate of change of a moment coefficient or the rate of the moment curve.
- Failure of an engine will demand more such noise damping, thus it may be possible to provide such in the design.

• Handling qualities criteria currently used as a guideline for defining the aircraft's satisfactory handling qualities of high performance aircraft. They should be determined with the supersonic transport—specifically as noted.

• Longitudinal approach and handling characteristics are inferior to those of current transport aircraft.

• Augmentation of longitudinal handling qualities may be necessary to achieve handling characteristics superior to those of current subsonic transport aircraft.

A rapid, responsive system of control is required which reduces the magnitude of standard deviations—was proposed by three authors from North American Aviation's Aerospace Division.

The first North American Aviation

engineer—G. M. Andrus, J. M. Johnson, Jr., and P. H. Gaudin—said the IAS that up to 90% acceleration allows them can be obtained this way, and that structural augmentation could be reduced to 50%. These results stem from both analytical and computer studies of the problem applied to supersonic aircraft at a cruise speed of Mach 3.

The rapid, responsive system is added to the aircraft automatic control system, it would add a few instruments and electrical networks to the control system of control surfaces, sensors, sensing instruments and electrical networks. The airplane model shows recently exchanged and the human pilot's control commands would not be changed or opposed by the system.

VTOL Transport

Writing at the effect end of the speed range, all air transport aircraft, from the front that was the transport, VTOL transport capabilities described some new details of their design (AW Sept. 25, p. 152).

A. L. Roberts, of General Electric Corp., presented a report on the design of a VTOL transport aircraft, the design designated VTOL-45A, he is author with D. H. Williams of North American Co. and C. W. McNeely of Hillier Aircraft Corp.

Conventional propeller and a tail rotor were selected instead of cycle propeller. Roberts said to avoid the disadvantages of a cycle control system and lightweight propeller blades. The 10-wing, cycle, long-range, lift and double-lifted tail rotor. The wing is mounted with a step, the dihedral of 15 degrees.

Complete lift is conventional except that there is no downward side control, separating lift and control. This is a jump start for the aircraft to keep constant. Engine rotation and control are grouped above and on the controls with the power flight panel in the rear fuselage.

New details of this system are described.

• Propulsion, with two General Electric T44 turbofan engines driving 15 ft by 15 ft propellers. Control surfaces are controlled between each engine and its propeller. Propeller power is integral with the propeller instead of being mounted to the engine. The gas turbine is connected with the propeller in the event of failure of the primary gas turbine system.

• Helicopters, with five aircraft engine starting power controls stabilization system and emergency.

First details of a helicopter system being developed by Hughes Aircraft Co. Andrus and Ames Research Center were described to the IAS by Melvin Sadali, vice president of re-



LOCKHEED SPOKESHIP, speaking before the 1978 annual meeting at the Institute of Aeronautical Sciences, confirmed information originally reported in Aviation Week (AW July 31, p. 140) regarding its rapid rotor helicopter. The CL-475 is a conventional helicopter with a rigid main blade, main rotor and a tail rotor. Weight of the vehicle is about 2,000 lb, main rotor diameter is 31 ft.

controls. A mechanical rotor control system is used to drive the rotor to the proper control action at a fraction of wing loadings. Dual stabilization system with four functions—roll, yaw, pitch and altitude—is designed to make 17 ft flight possible. During the hovering and transition phases, the system will provide stabilization of pitch, roll, yaw, pitch rate, roll attitude, roll rate and yaw rate.

• Helicopters, using a conventional propeller or gas turbine plus a variable frequency generator for propeller and engine rotation. These are also a variable control system as a generator driven by the engine, power and air ground control and completion of mission in the event of failure of the primary gas turbine system.

• Helicopters, with five aircraft engine starting power controls stabilization system and emergency.

First details of a helicopter system being developed by Hughes Aircraft Co. Andrus and Ames Research Center were described to the IAS by Melvin Sadali, vice president of re-

searching for the company's Aircraft Division.

New under suspension after borders, the Hughes system had been selected a total of 15 ft by mid-December last year. The contract calls for transition and approach at that point. The test runs will be in 1978. It is 15 ft in diameter, and planned around two General Electric T44 gas turbines. But because of the noise problem of the 1970s at the time a single T44 was used to drive the 15 ft rotor, the 1970s version was dropped overboard as superfluous to the requirements of the rotor.

The last test, that is not new, it has been generated for years and used for more years. In a helicopter, the exhaust gas from a turbine engine or other gas generator is ducted through the rotor system and then to the discharge of the rotor tips, producing a suction shock which slows the blades.

It should be noted that such a system required three phases before being used.

• Small, high-pressure-ratio turboprops to

Do you share his probing curiosity?



"Why" and "How" are more than words to him; they're a way of life. The need to know is an urgent drive that won't let him rest.

Are you a questioner by nature? Then come to Northrop. Pick your own area of investigation: from more than 70 active projects. They range from space guidance, life support and desecration systems to defense technology, electronic checkout and failure prediction systems.

Whether factors engineers, physicists and mathematicians for space electronics given a particularly needed just now, but if you have an active, seeking mind, there's bound to be a spot for you at Northrop wherever your specialty.

If you'd like to know more, write to Dr. Alexander Weir, Northrop Corporation, Box 1826, Beverly Hills, California. You will receive a prompt reply.

NORTHROP
A Division of General Motors

NEW AEROSPACE PRODUCTS



Magnetic Tape Recorder

New MTR-551LV recorder weighs 16 lb. and is designed to operate under temperature extremes (above or under ground, under water or in space).

The manufacturer says the recorder has been successfully tested for normal space operations at -112°F and at +140°F. The device incorporates a precision gear drive and a silicon rubber capstan as the tape mover. The recorder is available in seven or 14-channel heads and 1 or 1 in. tape moving at 7½, 25 or 100 ips., with continuous, 1/31, discrete or digital recording modes.

The instrument holds 75 lb. of 1 in. tape. Working parts are covered in stainless steel.

Leach Corp., 717 N. Coates, Aurora, Calif.



Camera Enclosure

Airborne-type camera shelter, designated C2K-1, is designed to provide mobility and environmental control of the instrument to increase efficiency and reduce maintenance requirements.

The shelter is of stainless-steel construction with two slabs of polycarbonate spaced glass fiber cloth bonded to a thermal insulating honeycomb core. The shelter is designed for conformance with the trailer-mounted provisions of the Navy Ordnance Test Station.

Available design is said to provide protection against solar radiation, thermal disturbance, dust, and fuel fumes. Fairchild Division, Hewlett-Packard Corp., 13522 Yukon Ave., Hawthorne, Calif.



Collapsible Fuel Cells for Army

Lightweight fuel cells are being produced for Army by Ling Electro-Voltage. Collapsible cell is designed to 12 in. high. Opened, the cell measures 40 in. high x 18 in. long x 40 in. wide. Maximum interior bag area is 650 sq. ft. with gaskets or other fuel for transport. Damage cost is less than \$100.

Cooling Blower

Four-stage metal vane blower for cooling electronic parts is said to deliver air as fast as 175 cfm against a static pressure of 2.7 in. of water at 1,450 rpm.

The unit measures 10 in. long by 5 1/2 in. dia. The motor is available in ratings of 400 or 600 cps, 220 v., three phase. Additional sizes for stages in the blower add less than 10% to the length. The manufacturer says the blower meets applicable specifications in MIL-E-7720C for vibration, shock, temperature extremes, leakage, humidity, condensation.

Torrington Mfg. Co., Torrington, Conn.



High-Pressure Compressor

New four-stage compressor is said to have inlet pressure of 10 psig. for delivery of 70 cu. ft./min. of an inert gas, helium or argon gas at 15,000 psig. discharge pressure.

Motor-driven unit has six cylinders and is air cooled, with water-cooled and maintenance-free between oil changes and a cooler and trap after discharge. Discharge temperature is 125° above ambient. The unit is designed to compress gas from regulated or shop-line supply and get from liquid storage and stop-vent gas from tube-bank heaters.

Casella Division, Maclean Engineering Co., Inc., Dept. 930-164, Lebanon, Ind.





NEW REDUNDANT LOGIC techniques which provide major boost in system reliability are beginning to see use in space and defense equipment. Use of three parallel channels with a majority vote between stages, one of the simplest approaches is shown in Fig. 2. More sophisticated techniques which further enhance reliability into redundant majority voting, as shown in Fig. 3.

Redundancy Utilized to Boost Reliability

By Philip J. Kline

Thames, N. Y.—General Electric is applying new redundant logic techniques to space and defense equipment with the expectation of increasing reliability by a factor of 100 to 1 in use.

Our indication of the growing interest in use of redundancy to boost reliability is a two-day symposium on Redundancy Techniques for Computing Systems which will be held in Washington on Feb. 6-7. GE will be one of the companies reporting on its work in the symposium which is sponsored by Office of Naval Research.

Although the concept of redundancy

to achieve increased reliability is not in itself new, it has only recently become feasible for space and flight-related use as a result of microelectronic construction techniques.

Scientists at GE's Advanced Electronic Center here are applying redundant logic techniques to a data processing relay which will be used in the National Aeronautics and Space Administration's Orbiting Astronomical Observatory and on an individual type of component for the Area Signal Group. The OASG processor will use approximately 5,000 conventional components; the Signal Group device will employ degraded (other than 50%) power components along

with discrete power diodes and transistors.

The redundant logic techniques under development here differ from some of the early redundancy concepts first proposed when the technique, called serial voting, is a possible source of boosting reliability. Those earlier concepts required that the equipment automatically detect a malfunction, isolate and verify the fault, and cut out of the circuit and switch a replacement into the circuit. This increased system complexity and prevented the opportunity for failure in the added detection and switching elements.

The technique developed here at the Advanced Electronic Center of GE's Light Military Electronics Department for use with digital (pulse) circuits employs three parallel channels, one of which could perform the required function if redundancy were not needed. The three parallel channels are interconnected at suitable junctions to take a "majority vote" to determine the present or absence of a pulse at any instant. If a malfunction has occurred in one channel, the other two will carry the "vote" to produce correct result.

By dividing each of the parallel channels into a large number of segments and taking a majority vote after each segment, it is possible for the system to experience a sizable number of faults in all three channels and still perform satisfactorily, provided the faults do not occur simultaneously in identical segments of two out of the three channels. The number of such segments, or powers of taking a vote, is referred to as the "level of voting."

Chart (left) shows reliability, given possible through use of parallel channels majority vote redundancy, and improvement with increased voting level. For example, a three-channel redundant system with only a single level of voting should be able to operate the first three or four of a nonredundant function with a 95% probability of not fail-

ing. If the level of voting is increased to 20, the system should operate for 17 times as long as a nonredundant system with a 95% probability.

GE's Norman H. West emphasizes that redundancy is not a substitute for good circuit design nor for the use of good quality components. Further, it is an additional technique for boosting reliability when the best components and circuit design are not adequate to meet operating requirements.

Operating Principles

In the simplest type of majority voting redundancy, the output from the three parallel channels are fed to a single majority element (see Fig. 4, p. 77) which can be made an analog signal, West says. If two or three of the three inputs is a pulse, the majority element output is a pulse. If two or three of the inputs is no pulse, the majority element output will be no pulse. This output then is fed to each of the next stages in the three parallel channels and repeated along the circuit.

The use of only a single majority voting element has the disadvantage that a malfunction in any single element can cause an error in the overall circuit output. For this reason, GE also uses redundant majority voting elements, one for each channel (see Fig. 5, p. 77).

With full three-channel redundancy, including the majority voting elements, failure would have to occur in two

channels at two majority elements in any stage of the circuit to cause an overall catastrophic logic malfunction, according to West.

It is possible to use five or seven parallel channels and take a three out of five or a four out of seven majority vote. However, the increased circuit costs usually offset the small gain in reliability so that use of three parallel channels is the configuration, West says.

Continuing demonstration of the reliability of majority voting redundancy logic techniques to individual component failures is provided by a simple three-channel system with five stages which the Advanced Electronic Center has built into a small national standard logic technique to individual component failures is provided by a simple three-channel system with five stages which the Advanced Electronic Center has built into a small national

The circuit used is a random sequence pulse generator, referred to as a keystone generator. The designers first selected a non-redundant keystone generator which served as a standard of comparison to determine whether faults automatically introduced into the redundant keystone generator had altered its final output, or caused an overall circuit malfunction.

Introducing Failures

Open circuit and short-circuit type failures can be introduced into an as many as the 145 active components in the redundant circuit keystone generator in a manner affecting both of metal plugs into pins on the demonstration panel. For simplicity, no provision has

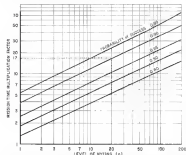
been made for introducing failures into the passive components, but virtually every type of such failure can be simulated by suitable choice of active component malfunction, according to GE's Richard F. Hildrich.

In a demonstration in Avionics Week, various combinations of short and open circuit faults were introduced throughout the redundant circuit without producing an erroneous output, so long as no more than one channel was loaded at one single stage. Thus, five static component failures could be introduced simultaneously in this relatively simple circuit without producing an error in its output.

Component Increase

Use of parallel channel redundancy with more levels of voting increases the number of components required by a factor of at least three with a four majority in one-out equipment use and weight. This technique would not be feasible for area defense and space applications were it not for recent advances in microelectronics techniques.

To illustrate what can be accomplished with current state-of-the-art, GE has built a second redundant logic keystone generator identical in performance to the one described, but fabricated with dual in-line technology and using bonded pass transistors. The on-board redundant (three-channel, five-stage) circuit, containing 116 transis-



INCREASED MISSION (red line) time between failure increases significantly with use of redundant circuitry with even greater reliability as the number of voting channels is increased, according to GE studies. For example with 20 voting channels, mission time between failure is increased by 17.5 over one redundant system for 95% probability.



PORTABLE DEMONSTRATOR built by General Electric (left) to show how new redundant logic circuitry produces substantially greater fault tolerance introduced by means of three parallel plugs inserted in lower panel. Thus, specific circuit can be combined in easily isolated plug-in assembly a failure of only one cubic inch function. This film-type circuit developed by GE uses deposited conductors and resistors, copper on ceramic base, and employs two metal terminations (black dots) mounted on the substrate (GEL). GE is building three-channel, seven-stage redundant logic device containing 490 transistors which will accept a value of about two cubic inches.

Look to United Aircraft's CORPORATE SYSTEMS CENTER

... for scientific breakthroughs
... for career acceleration

You can count on the **United Aircraft Systems Engineering Team** to create and develop breakthroughs in advanced radar guidance systems development, mobile ballistic missiles, terminal air defense, orbital rendezvous and other advanced areas. The UAC is accelerating the integration of its broad technical resources and R&D capabilities toward the "build up" of the aerospace industry's most effective missile and space group.

Scientists and Engineers who want to advance their professional growth and technical competency will find it advantageous to talk with Corporate Systems Center Representatives—**positions are available at all levels.** The pace and challenge are rugged... opportunities for personal achievement and advancement unlimited.

DESIGN, ANALYSIS, DEVELOPMENT AND RESEARCH in such areas as:

Aerodynamics	Weapons Effects	Propulsion
Colloidal Mechanics	Instrumentation	Reliability
Computer Design	Environmental Factors	Space Research
Computer Programming	Mathematics	Structural Design
Dynamics	Operations Analysis	Space Physics
Electronics	Visual Distance Components	Thermodynamics

Positions are also open in:

Systems Engineering	Manufacturing Planning
Program Planning	Marketing
Systems Integration	

Please submit your qualifications to: Mr. A. J. Fehrer,
Supervisor of Professional and Scientific Placement.

United Aircraft
CORPORATE SYSTEMS CENTER
Windsor Locks, Connecticut

An Equal Opportunity Employer

tor, occupies a volume of only one cubic inch (See photo, p. 77). The large crystal consists of a 5 m. ceramic and the entire generator consumes less than 250 milliwatts.

The large crystals used in this micro-electronic vacuum capsule device replaced transistors, current switching and necessary gating capable of performing the generator and the output rectifying functions. Additionally, the crystal is designed to use no external components so it can be produced entirely to provide the thin deposition techniques. The crystal also can be fabricated using new diffusion processes employed to fabricate integrated circuits.

Signal Corps Device

The substantial large device which CFI is building for the Army Signal Corps will incorporate three parallel channels and output rectifier. It is expected to operate about 400 mhz for use in three field receivers and be easy about two cubic inches.

The parallel channel supports varying type of nonlinearities but eventually will relate to digital type circuits but a more difficult to apply to analog type circuits, West concludes. However, GE engineers have an existing this problem and are hopeful that this technique can be adapted to analog type circuits.

SPS FILTER CENTER CASS

■ **Advanced Ruby Competition—Natal Electronics Laboratory.** San Diego plans to hold an industry competition soon for large solid-state oscillators.

■ **Low-Cost Beacon Contracts Awarded.** Federal Aviation Agency has selected Hamilton Corp., Indianapolis, and Transco Products, Inc., Los Angeles, to develop lightweight low-cost transponder beacons for general aviation use under contracts totaling \$17.1MM. The low cost transponder are a vital extension of the traffic control system recommended by recent Program Beacon study group. Hamilton, scheduled to deliver 10,000 units in about 18 months, is using more conventional design approach, while the Transco design is less orthodox and may result in a unit weighing less than 6 lb, according to FAA.

■ **Rapid Radiance Tester Developed.** An automatic microwave interferometer that can check microwave phase shift in a radome as a function of air velocity and stream data for a half 360° in only .20 sec., has been developed and built by General Dynamics/Fortona. Previous techniques required at least an hour to measure phase shift at 10 positions on the radome, compare and



Continuous-Operating Ruby Optical Maser

Ruby optical maser which has been operated continuously for first time by Bell Telephone Laboratories scientists was now technique which discharges pumping power by factor of more than 100 (AW Jan. 25, p. 10). In early last shown at left the maser laser began when pump power level reached 500 watts. New pumping technique uses two crossed mirrors (right) to reflect light from maser as to heat line of transparent-doped sapphire crystal (right) to reflect light from a thin disk of chromium-doped aluminum oxide (ruby). Light from the so long a reflected intensity of it broadens the cone, increasing its strength, and a reflected beam from the above end of the tube and with further enhancement. New technique will enable scientists to give access to ruby crystal during operation to expose it to impure fields and mechanical strains. EIT, nyc.

■ **More Than Five R&D—Another** than five programs aimed at various applications of semiconductor and conductive films, will be launched by the Electronics Technology Laboratory of USAF's Aeronautical Systems Division. Program will look into outside problems from flow. It is one of a series in the semiconductor that the area which PTL is examining in its search for new and diverse components. Proposals were due in December last month.

■ **Reliability Workshop Scheduled.** Army Research Corp. is planning to hold a four-day workshop covering reliability techniques both theory and application. Charge will be \$300 per person. For information on the course write: Army Research Corp., 1700 K St. N.W., Washington 6, D.C. Attention: W. T. Wilson, Jr.

■ **Simple PERT Computer Developed.** Staff has now making computer for calculating project activities, including PERT and similar control techniques has been developed by Manville Associates, 15 Washington Pl. The new program, called "SketchIt" is said enough to aid step a click.

■ **New L-Sensor Development.** Air Force's are progress to develop an L-Sensor, AN-150 47 aerial refueling control system for quickly, accurately to establish aircraft around the globe, on which radars is sending passively, has been designated as 462 L. It is being managed by the Electronics Systems Division's 471-L system project

office (SPCO), under Col. Maria F. Peterson, which now is identified as 471-L/462 L.

■ **Maser, Laser Military Radar Probed.** Standard Research Institute will deliver a report to the Army Chief of Research and Development Office on Apr. 1 concerning possible and anticipated radar applications for the instrument and optical maser and related devices. The report also will predict technical and scientific trends in stimulated emission phenomena. Army will use the report for its research planning activities. Report will be based on Standard survey of organizations conducting R&D and

Missile Automation

An First has given Lockheed Martin and Sperry Division permission to examine missile automation of the Mako missile, making missile system after a series of studies which had aimed one determination in industry (AW Jan. 5, p. 15, Nov. 18, p. 79).

Lockheed plans to use proposed requests in April for first parts of the system which it will integrate into a new plane system capable of automatically detecting and the Mako through the field detection of such launch. Contracts will be awarded in June.

The four separate parts to be processed for the system from industry are:

- Large digital computer and switching gear;
- Ground handling support equipment;
- RF equipment;
- Simulator to simulate Mako launch.

93% of the answers stressed Opportunity for Professional Advancement We Have It— and here's how it works...

(1) Twenty Seven Management Selection Committee members, in a completely unbiased and confidential system to find the best qualified individuals for 18 openings which arose.

In the past 1961 they spent only twenty five hundred man-hours while doing significant work.

For every opening which arose, these capable members did a thorough job of screening and they came up with one outstanding request, but I want them now to be used to qualifications, the involved input must first be the best choice.



(2) Management Development, as the entire team, focusing to improve and aid those employees who wish to further develop their capabilities and skills.

If the system appears to YOU in offering you today for YOUR further development and advancement—write us today!

THE ENGINEERING CENTER
LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION
AN EQUAL OPPORTUNITY EMPLOYER

Where we find
there's **MORE** of what **MORE** Engineers want **MORE** of



ENGINEERS Have YOU Answered This Invitation Yet?

It appeared in the January issue of Scientific American, Aviation Week Aerospace Engineering, Aerospace Management, Space, Astronautics and a number of other publications. Answers received to the feature have already offered a considerably high percentage of the advantages desired by the majority of Engineers and THAT WE CAN NOW AFFORD TO OFFER A PORTION TO FIT THE REQUIREMENTS OF THE EMPLOYEES. Now I want you to tell me your ideas and requirements so we can offer you the challenge you want them to bring us WHAT YOU WANT!

We challenge YOU TO DO IT NOW!

*Tell us what
you want*

MAIL TO:

Hugh L. Gordon
Professional Employment Manager
Lockheed-Georgia Company
604 West Peachtree Street
Atlanta 6, Georgia Dept 352

WHO'S WHERE

(Continued from page 23)

Changes

George Stokley, head of the newly created Space Systems Branch of Boeing Co.'s Aerospace, Denver, Seattle, Wash.

Dr. G. A. B. Hughes, chief, Manufacturing Technology Laboratory, Aeronautical Systems Division, Wright Patterson AFB, Ohio.

Dr. Peter B. Myers, manager of the newly established Research and Advanced Technology Department, Martin Marietta Electronic Systems and Products Division, Johnson, Md.

Edward C. Morse, manager, Manufacturing Engineering Division, Lockheed Corp., Wichita, Kan.

Robert K. Pardo, Jr., managerial engineering, Computers and Data Systems Division, Aeronautical Division of North American Aviation, Inc., Anaheim, Calif.

William V. Shanks, manager of the Electronics (M) Division of Wyle Laboratories.

Stephen Auerbach, Co's Research Laboratory, Natick, Mass., has appointed Dr. Donald G. Lutz chief scientist to direct studies of satellite communications.

Albert L. Landegren, sales manager, Transducer Division of General Controls Corp., Pasadena, Calif.

Dr. Paul Kirk and Dr. Rolf H. Hensel have joined the Control Systems and Designing staff of Texas Instruments Inc., Dallas, Tex.

Stanley Willey, assistant general manager, Systems, Texas Instruments, has joined James E. Dillman, senior supervisor, Aerospace Department, Pacific Northwest Corp., Richland, Wash.

Kenneth C. Garbuck, engineering manager, Wyle Laboratories Personnel and Support Training Division, Wichita, Kan.

Robert E. Brundage, manager of a new Special Systems Department at the Washington (D.C.) Division of System Development Corp.

Don R. Apple, manager of the newly established Special Systems Department, Burroughs Corp., with headquarters in the company's Federal Government Activity, Washington, D.C.

Edmund C. Oels, manager of the Dynamics and instrumentation laboratory program, Electronic Research, Inc., Bethesda, Md.

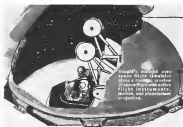
Dr. Raymond D. Egan, manager of motion research, General Atomics, Philadelphia, Pa.

Robert B. Swenson, director of program space Northland Airlines, Inc.

Lytle C. Cleveland, manager, Wyle Laboratories Manufacturing Division, El Segundo, Calif.

A. E. Burt, Jr., purchasing manager, Palomar Research Corp., Concord, Calif.

Dr. W. William Widely, general manager of the newly formed Solid State Systems Division, Motorola Inc., Phoenix, Ariz.



FOR IMAGINATIVE ENGINEERS...A FULL RANGE OF AEROSPACE FACILITIES

Automatic controls evaluation, space environment and manned space flight simulators, structures and materials laboratories and wind tunnels are just a few of the facilities which engineers and scientists apply to aerospace programs at Chance Vought in Dallas. Vast resources and emphasis on individual creativity at Vought give you the opportunity to achieve maximum potential and greater stature in your profession. Programs like Scout, Saturn, VTOL, Crusader and others have created new career opportunities. If you have a degree in engineering and direct industry experience, you can share in the rapid expansion in these areas: • Trajectories Analysis • RF and Antenna Systems • Conceptual Design • Aerodynamics • Structures • Dynamics • Stability and Control...

SEND YOUR RESUME TO: PROFESSIONAL PLACEMENT DEPT. AW-2 CHANCE VOUGHT P. O. BOX 5907 DALLAS 22, TEXAS

CHANCE VOUGHT subsidiary of Long-Tec-Vought, Inc. an equal opportunity employer



March 12, 1962

**29th Annual
Inventory
of
Aerospace
Power
Issue**

A review and preview of
world-wide aerospace developments

For 29 years...
**Anticipated
read
respected**
as the
**recognized
authority**
on aerospace
technical progress

A powerful editorial force is a powerful selling force.

Aviation Week
and **Space Technology**

A McGraw-Hill Publication 200 West 42nd St. New York, N.Y. 10018

ABC PAID CIRCULATION 81,657



AiResearch Needs Engineers for

SPACE ENVIRONMENTAL CONTROL SYSTEMS

AiResearch immediately needs preliminary design, creative board-type designers and hardware development engineers at all levels, with backgrounds in the following disciplines:

**Thermodynamics
Fluid Mechanics
Heat Transfer
Controls**

**Stress and Vibration
Systems Engineering
Cryogenics
Test Engineers**

Here is an opportunity to participate in a major expansion of a company which pioneered the space environmental field. Specific experience in space environmental controls is desirable but not necessary. Education requirements are B.S. and up. Garrett is an "equal opportunity" employer.

For interview arrangements, please send complete resume to Mr. Tom Watson



AIRESEARCH MANUFACTURING DIVISION
9651 So. Sepulveda Blvd., Los Angeles 45, California



DESIGN ENGINEERS

Why you should know more about

MCDONNELL

In the 50 years since its founding, the McDonnell name has become associated with an increasing number of outstanding engineering achievements in aerospace and aeronautics.

Among these are America's fastest transport with the DC-8 — the outstanding F4 Phantom II, all weather fighter and air tank airplane now the world's fastest jet.

And here — PROJECT GENIE—McDonnell has undertaken the design and construction of an unmanned, free wing aircraft for NASA capable of sustained with engine operation while in orbit around the earth.

The extensive McDonnell facilities encompass modern computer engineering research laboratories and production facilities are located in suburban St. Louis, Missouri. Diverse industry and consumer, well-defined cultural and entertainment centers and a comprehensive medical facilities complex provide an excellent area in which to work and reside.

Present and planned phases of our activities have created these career opportunities.

DESIGN ENGINEERS

Must have ability to create original structure or mechanical designs and develop concepts and actual configurations in design, optimum performance. Develop design from customer specifications following into manufacturing process requirements. High environment and vehicle performance. BSME, MS or CE required.

Please submit resume in confidence to:

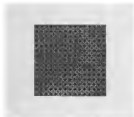
Mr. D. F. Waters,
Supervisor of Engineering Employment,
Box 400

MCDONNELL
P.O. Box 518, St. Louis 63, Missouri

An Equal Opportunity Employer

IBM asks basic questions in manufacturing research

How can we make what we invent?



This is a three-by-three inch microconnection board (shown actual size). A single 3"x3" microconnection board can hold up to 4000 electrical connections.

Distances within computers are shrinking, transforming microseconds into lengthy intervals and thousandths of an inch into large measurements. The adequacy of time-honored manufacturing techniques is shrinking along with them. IBM is investing new manufacturing capabilities to make sure that tomorrow's discoveries will find production lines waiting for them.

IBM builds new manufacturing technologies based on research. It has set manufacturing research free from day-to-day production pressures to concentrate upon manufacturing problems specific to new product technologies. Manufacturing research conducts broad inquiry into the fundamental nature of manufacturing concepts and processes. In addition to its own program, IBM carries on manufacturing research projects with universities and research institutes.

Manufacturing researchers examine manufacturing processes before products are developed. Recently, when development of micromodule circuitry started, manufacturing researchers studied possible interconnection techniques. This analysis suggested an arrangement of laminated circuit planes which, combined with a standard



This is the 10x10 microconnection board magnified 30 times. The circuit planes are formed by successive coating, etching and washing copper-clad phenolic.

matrix, permitted automated production of complex, miniaturized interconnection packages. This interconnection technique makes and breaks standard conductor patterns to form the circuits required on individual pieces of hardware. Specialists in fields as diverse as physical chemistry, metallurgy, and hydraulic servo-systems all contributed to its development.

In other current projects, IBM manufacturing researchers skilled in many scientific disciplines are studying technologies involving magnetic coating by electrophoresis, the effect of heat treatment on wave propagation in metals, and high-energy rate forming. Out of their research may come the discoveries that make tomorrow's manufacturing systems possible.

If you have been searching for an opportunity to make important contributions in manufacturing research, or in software development, optics, solid state physics and many other fields in which basic questions are being asked at IBM, please contact us. Write to Director of Professional Employment, IBM Corporation, Dept. S2401, 590 Madison Ave., New York 22, New York. IBM is an Equal Opportunity Employer.

New Study Contracts Plus Expanding Weapons Requirements Enhance the Variety of Responsibilities for Systems Analysts at Raytheon's Missile & Space Division

SYSTEMS REQUIREMENTS ENGINEERS

Engineers qualified in system requirements and evaluation of its operational analysis and computer simulation will find challenging assignments in areas such as the following:

GROUND BASED SYSTEMS — HAWK, AIRPAT, BRAM, Hard Site Defense

AIRBORNE SYSTEMS — Sperry or RL TFX Advanced Penetration Aids

TECHNIQUE STUDIES — Compression Scanning Array Radar (COSAR)

TECHNICAL INTELLIGENCE

In a diversified product-planning program, the Missile & Space Division is actively investigating weapon systems and support systems for both offensive and defensive missions.

If interested and qualified, please forward your resume to Mr. William O'Malle, Bedford R & D Center, Raytheon Company, Bedford, Massachusetts.



RAYTHEON COMPANY
MISSILE & SPACE DIVISION

An Equal Opportunity Employer

Your Inquiries to Advertisers Will Have Special Value . . .

—For you—the advertiser—and the publisher, if you mention the publication. Advertisers value highly the evidence of the publication you read. Satisfied advertisers enable the publisher to secure more advertisers and—more advertisers mean more information on more products or better service—more value—to YOU.

The Effectiveness of your Engineer Recruitment Advertising is Measured by the Calibre and Quantity of the Experienced Engineers it Reaches.

The man you need is the man who reads

Aviation Week
— *Airline Technician*
CLASSIFIED ADVERTISING
DIVISION
POST OFFICE BOX 12
NEW YORK 36, N. Y.

MACH 3 TURBOJET LIQUID HYDROGEN ROCKETS

DIVERSITY... at PRATT & WHITNEY AIRCRAFT

CRYOGENICS
HYPERSONIC PROPULSION
RL-10
DIRECT ENERGY CONVERSION
GAS TURBINES
FUEL CELLS
NUCLEAR



... creates engineering careers in Connecticut and Florida

Diversity... spreading the field of space age power... provides challenging opportunities for engineers and scientists at the East Hartford, Connecticut Plant and Florida Research and Development Center of Pratt & Whitney Aircraft.

From the position of more than 35 years of leadership in the flight propulsion field, P&W is contributing experience and imagination to advancing the state of • space technology • military and industrial powerplant development • surface locomotion • marine and submarine propulsion • and a varied field of energy conversion systems.

EXCELLENT FACILITIES Privately owned facilities provide for the accelerated development/testing of advanced powerplants, advanced rocket motors, high-thrust turbojet engines, and full-scale rocket components. Further aiding our engineers are comprehensive automatic data acquisition and processing systems, including the latest in computing facilities.

Engineers and scientists at all levels of experience are invited to investigate the unusually creative climate and the opportunities to further professional stature at Pratt & Whitney Aircraft.

Please contact your nearest recruiting institution early requirements to:
SEE IT IN NORTH BRIDGE 26 SEE IT IN NORTH BRIDGE 26
PRATT & WHITNEY AIRCRAFT PRATT & WHITNEY AIRCRAFT
1000 MAIN STREET 1000 MAIN STREET
NORTH BRIDGE 26 NORTH BRIDGE 26
FLORIDA FLORIDA
All applicants will be handled promptly to complete positions.

Pratt & Whitney Aircraft DIVISION OF UNITED AIRCRAFT CORP.

An Equal Opportunity Employer



Over 80,000,000 pcs.
Lightweight
Elastic Stop® nuts
(including AN, MS, NAS Types)

STOCKED BY ESNA

FOR EVERY AEROSPACE INDUSTRY REQUIREMENT

To guarantee availability in the United States and Europe, Esna maintains four big stockpiles at

Beverly Hills, California Phone CR. 4-8071 TWX-BV. 6718	Collins-Powell Company 9247 Alden Drive
Kansas City, Missouri Phone DE. 3-8394-5 TWX-KC. 366	Elastic Stop Nut Corp. of America 226 West 75th Street
Union, New Jersey Phone MU. 6-6000 TWX-UNVL. 691	Elastic Stop Nut Corp. of America 2330 Vauxhall Road
Antwerp, Belgium Phone 396826	Intair Antwerp Airport

In addition to providing "availability," ESNA's leadership in the field of lightweight self-locking nuts is based on dependable quality and production of the full range

of shapes and sizes to meet every fastening requirement of the design engineer. This photograph, for example, illustrates *only part of the complete line of fully qualified NAS parts* which ESNA produces and stocks as standard items. For your copy of ESNA's Aerospace Fastener Catalog of miniaturized, lightweight designs, write Dept. S68-225.



**ELASTIC STOP NUT
CORPORATION OF AMERICA**

2330 Vauxhall Road, Union, New Jersey